provides a uniformly increasing voltage without interruption to the supply.

by rotor resistance, putting a high voltage on the stator and

THE

ELECTRICAL REVIEW.

VOL. LVIII. APRIL 13, 1906. No. 1,481.

ELECTRICAL REVIEW.

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CO-OPERATION AND RETRENCHMENT ON RAILWAYS.

A RECENT issue of the Financial and Commercial Supplement of the *Times* contained matter of high importance to all interested in British railways. The first article was by Mr. R. Price-Williams, and its purpose was to draw general attention to the power, which has been latent since 1844, of the State to purchase upon three months' notice after 1865 every railway in the United Kingdom. Doubtless that is no news at all to those most concerned, but to the general public, and even to the majority of the readers of this journal, it is probably unknown or forgotten.

It appears that the Government was badly bitten by its own Act when, in 1871, it bought out the telegraph companies, who were really only short-term lessees of the railway companies, and then had to pay three millions to the latter for their rights under this 1844 Regulation of Railways Act.

Although no nearer in reality, the knowledge of the terms of this Act (Clause 2) may bring the nationalisation of railways more within the range of possibilities than it has been hitherto to the average man-in-the-street.

When reading that the terms of purchase are to be on the basis of 25 years' purchase of the average of the three preceding years' divisible profits, one cannot help but compare these terms with the deservedly-named iniquitous terms of purchase laid down by Sec. 43 of the Tramways Act of 1870, and it is impossible to conceive how two such widely different bargains could be on the Statute Book at the same time. Are we to suppose that the standard of public equity was stronger in 1844 than in 1870?

If a change of Ministry had not occurred in 1866, it is almost certain that the Irish railways would have been taken over by the State, for Mr. Price-Williams himself was chief of the staff of engineering assistants who valued them. Naturally they are of much greater value now.

Mr. Price-Williams thinks that the intimate co-operation of railway companies would have the effect of inducing the State to purchase the whole, and his opinion is entitled to the greatest respect, but something, too, may be said for the view that the State would be enabled to purchase at a more favourable price, with less difficult preliminiaries, and without disturbing the money markets of the world to such a degree, if the companies continued in their policy of comparative isolation from each other.

The capital at par of the whole of the British and Irish railways is over one thousand million pounds—an amount which dulls our comprehension by its vastness; and it is so vast as to render any all-embracing scheme of State purchase out of the question. If it is accomplished at all, it must be undertaken by degrees, and in that case, the obvious strategic move is to extend co-operation until it becomes amalgamation of all interests.

The results of amalgamation have not been always for the good of the public, whatever they may have been for the shareholders, but that a greater measure of co-operation is needed in the real interests of both is patent to everyone who travels at all, and not only co-operation between companies, but internal administrative and executive reforms are called for, if we have any sympathy with the speech of the chairman of the Railway Investment Co. on the occasion of the annual meeting on March 22nd. We all know how he and his colleagues have instituted and courageously maintained amidst a continuous hail of blows from those who stick to the old ways, a crusade in favour of a more useful and a more detailed analysis of expenses and revenue. They are the exponents of the ton-mile and train-mile system, and they maintain that an acquaintance with this system would indicate immediately and constantly the directions in which economies ought to be made or new methods tried.

It is at least significant of the general truth of their preaching, although it must not be accepted on these grounds alone as absolutely and infallibly true for all possible cases, that the North-Eastern Co. when under the guidance of Sir George Gibb trimmed its analytical sails anew by the light of the methods which have been found indispensable by the great railroads of America, where competition is, if anything, keener than here, and have found themselves heading at once more strongly for the mark. "In 1899 the earnings of a N.E. freight train were only 80d. per train-mile. But by the adoption of a better system of handling traffic, *based on a sound system of statistics*, that figure has been raised to 123d. for 1905, or no less than 55 per cent. . . . If the goods traffic for 1905 had been worked on the same lines as it used to be worked in 1899, the N.E. would have run 6,400,000 more freight train-miles than they have run." That is an economy of 36 per cent. within six years after adopting a more elaborate, but a more helpful, system of statistics.

Certainly, the innovations which the Hon. George Peel urges as indispensable to the welfare of the shareholders he represents, do appeal very strongly to everyone who has had to do with the business side of that cousin of a main line railway, the street tramway.

The opposition, of which, alas, the L. & N.W. Co. is the head and front, holds that there is very little analogy between the two, but it must be admitted that their grounds for this assumption are somewhat obscure. The greatest difficulty exists now, and must exist until the proper statistics are available, in making anything like a probable estimate of the expenses and revenue which would result from a change in the method of propulsion, and the same difficulty must be encountered whenever estimates involving similar calculations have to be made.

The changes suggested, therefore, have something to do with electrification, and it can be shown, we think, that they have a very great deal to do with it, for until the present capital returns more to its holders than it does now, the prospect of electrifying anything but a minute proportion of the total mileage, must be remote.

Mr. Price-Williams reminds us that although the average rate of interest paid on the entire capital of British and Irish railways in 1904 was 3·36 per cent., 86 millions received nothing at all, 60 millions less than 2 per cent., and 437 millions less than 3 per cent., and he points out in a trenchant way that a reduction of the present excessive ratio of expenses to revenue (62 per cent.) is the direction in which the greatest efforts must be made. Fifteen years ago, and for the 34 years preceding, the ratio was 52 per cent., and a return to that figure would have made a difference to the shareholders of 11 million pounds in 1904. He thinks that much may be done by closer co-operation between interests which a spirit of crass selfishness hitherto has made to seem opposed, while the Hon. George Peel and his colleagues take the line of "more light" to help see where the wastage and cramped development lurks. Neither are antagonistic and both are right.

We recommend most earnestly to the big roads the more serious consideration of all these proposals, for the reclamation of that £11,000,000 per annum would mean a great deal to the electrical profession and industry.

The Economy of the Motor Drive for the Machine Shop.

This subject has been touched upon so frequently that it would appear difficult to find anything new to say about it. It is, however, necessary from time to time to restate the conditions in view of the astonishing claims put forward for mechanical systems of driving, by suction gas plants, oil engines and the like.

An article published recently in our New York namesake, from the pen of Mr. E. R. Douglas, deals pretty fully with the economy and other advantages of electrical driving. He points out that the first applications of the individual drive were in printing works where the evident cleanliness and easiness of control were very early appreciated. In machine shops the individual drive was first applied to the equipment of travelling cranes, where the absence of belts and overhead gear was an obvious advantage. After this the advantages of the motor-drive began to be apparent, and these are the following :—

1. Clear overhead room for crane service.
2. Better light and ventilation, since unobstructed by belts and shafting.
3. Absence of dirt and grease thrown about by moving belts.
4. Reduced fire risk from dusty, oily moving belts.
5. Cost of repairs and upkeep on hanger-boxes, belts and countershafts eliminated.
6. Greater flexibility of shop arrangement, location of machines where most convenient without reference to lines of shafting; possibility of rearrangement to suit changed conditions.
7. Convenience of motors for driving auxiliaries, moving heavy parts of machines and operating extra cutting tools on special jobs.
8. Entire absence of power loss when machines are not in operation.

Even with these admitted advantages the spread of electrical driving was comparatively slow until the introduction of high-speed steel for cutting tools, and the development of practical variable speed motors. The importance of the cost of labour in manufacturing then began to receive more attention. The author gives comparative costs of manufacturing an article with the mechanically-driven system, and the electrically-driven system. He shows that for an article costing $1, the cost of labour can be reduced from 40 per cent. to 36 per cent. of the total cost by increasing the output, that is to say, the speed of working, by 10 per cent. The cost of power is given as 2 per cent. in both cases, so that an increase of 10 per cent. in the output is worth more than double the whole cost of power. The full comparison is as follows :—

	Mechanical drive. Per cent.	Electrical drive. Per cent.
Material	50	50
Direct labour	30	27·3
Indirect labour	10	9·1
Power	2	2
Supplies, repairs, maintenance...	3	2·7
Interest and depreciation on plant	4	3·6
Insurance, taxes, &c.	1	·9
	100	95·6

The apportionment of cost varies considerably in different establishments, but the general character of the results obtained by decreasing the labour item would not be greatly different to those shown in the table.

The writer then discusses the various methods of speed control and groups these under two-wire, three-wire and four-wire systems. He shows that whereas until recently it was not practical to vary the speed of a motor by means of shunt regulation more than about 30 per cent., speed ranges can now be obtained as high even as 6 to 1. The size, of course, in the latter case for a given power becomes very great as compared with the size and speed of the motor for the same output without shunt control. With the three-wire system 4 to 1 range can be got with a motor having a 2 to 1 range in itself, and with a four-wire system a 6 to 1 range can be got under the same conditions. By four-wire system the author is not referring to the system such as we have in Manchester in which the voltage across each pair of wires is the same. The "multiple voltage" system is referred to in which a motor-generator having, say, 250 volts across its outers, has three armatures in series giving respectively, say, 60, 80 and 110 volts, from which six different voltages, and, therefore, six speeds can be obtained without the interposition of any resistance. Intermediate speeds are obtained by means of shunt regulation. This is a system which, whilst it may be largely in use in America, has not obtained much support in this country, and it is doubtful if the additional complication of the four-wires and special motor-generator justifies its use in preference to one motor with shunt control; or, say, a three-wire system; or a motor provided with two commutators when run on a two-wire system.

The author discusses in detail the conditions of operation and the range of output from machine tools, such as lathes, &c., when motor driven, or belted in the ordinary way.

Journalistic Etiquette.

English journalism has always been anonymous, and it has ever been recognised that correspondence should also be allowed to preserve its anonymity, save and except to the editorial eye. Yet, curiously enough, attention will be given to statements made in the editorial columns of a paper which, even though they had passed the editorial supervision, would not be favourably received were they to appear as anonymous correspondence. Now, there are ninety and nine reasons why a correspondent may elect to remain anonymous, and since journalistic etiquette has long sanctioned the practice, it appears reasonable to ask that common courtesy should be accorded to him.

In several instances correspondents of the Review have girded at the anonymity of other correspondents, as though these had no claim to be heard. In some cases mere criticisms of facts and figures have been taken as giving personal offence. This we hold to be quite a mistaken view. The anonymity of a letter does not alter its value in a technical sense, nor does it form a valid excuse for non-reply by a man who has been tripped up. Such criticism must be taken at its face value, whereas signed letters often obtain a degree of acceptance to which they may not be entitled by their contents. The unsigned epistle may be written by the head of the firm or by the junior draughtsman, and if no one can decide by which, then so much the worse for the chief, or so much the more credit to the humble junior.

Were anonymity of articles and of correspondence to be abolished, some of the best articles and best letters in this and other journals would never have appeared.

To compare such contributions of which the authorship is known and approved by the editor, with the anonymous letter of the informer is to show a want of the sense of proportion, and is not complimentary to editors, whose duty it is, under existing customs of journalism, to allow such to appear.

SOME NOTES ON THE REGULATION OF ROTARY CONVERTERS.

By ALFRED STILL, A.M.Inst.C.E., M.Inst.E.E.

A rotary converter, consisting as it does of an armature with a single winding fed through slip rings with alternating or polyphase currents, and delivering direct current through brushes bearing on a commutator, may be looked upon as a combined synchronous motor and direct-current generator. The chief difference between such a machine and a motor-generator is that the latter has two distinct armatures, which, although rigidly coupled together, revolve in separate systems of field magnets, thus rendering the regulation of pressure an easy matter. The synchronous motor will run at constant speed, and the field ampere-turns of the direct-current generator have merely to be varied by any of the usual means in order to obtain the desired pressure regulation at the direct-current terminals.

The rotary converter, however, has only one armature, the speed of which is determined solely by the frequency of the polyphase supply current; and if the alternating E.M.F. across slip rings is constant, the induced E.M.F. is also approximately constant, which involves the idea of a constant magnetic flux cut by the armature conductors. If the current in the field coils is not large enough to produce the required flux, the armature current will automatically adjust itself as regards both magnitude and phase until there is a (lagging) magnetising component of the total current capable of producing the balance of the required magnetising ampere-turns. If, on the other hand, the current in the field coils is greater than it need be, there will be a *leading* component of the armature current such as will produce the necessary demagnetising effect to keep the magnetic flux at the required strength. In this respect the rotary converter behaves exactly like a synchronous motor: and since any

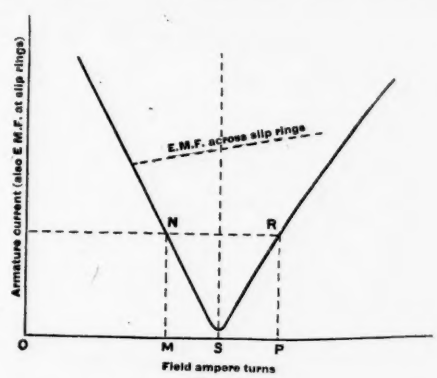


Fig. 1.

attempt to strengthen the field in order to raise the pressure across the brushes is immediately met by a demagnetising component appearing in the armature current, it would appear at first sight as if the maintenance of constant pressure by the addition of a series-field winding were an impossibility.

But rotary converters are compound-wound with entire success, and it is with a view to explaining the manner in which this compound-winding enables the pressure across brushes to be maintained constant at all loads that this article has been written. Starting with the principle of a definite transformation ratio between alternating and direct current pressures, it follows that if the pressure of the polyphase supply is raised or lowered, then the direct current pressure will be varied in a corresponding manner. This suggests what is, perhaps, the most perfect method of regulation, namely, the employment of variable ratio step-down transformers, by means of which—even with constant pressure at the H.T. terminals of the polyphase supply—the volts across slip rings can be varied within the required limits. This regulation can be done by hand or automatically; but automatic regulation on these lines would be costly and liable to give trouble owing to complication of parts. The other method of varying the pressure across slip rings, which

is automatic in its action, requires the compound winding of the field magnets; but this—as will be understood from the foregoing remarks—will not lead to the required pressure variation, *except under special conditions* which permit of this result being attained.

These conditions are that there must be an appreciable amount of self-induction in the circuit between the H.T. supply terminals (at constant pressure) and the slip rings of the rotary, and that the ohmic resistance of this portion of the circuit must be relatively small. If the step-down transformers are of a type having a fair amount of magnetic leakage, it may not be necessary to provide additional self-induction in the form of choking coils; but, in practice, a small choking coil is usually inserted in each of the polyphase leads.

In fig. 1 (p. 579) the full line curve shows the relation between armature current and field excitation for a rotary converter or synchronous motor running light. The ordinates, or

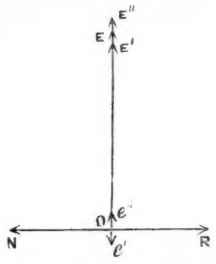


Fig. 2.

vertical measurements, indicate the amount of the armature current, while the horizontal measurements represent the ampere-turns on the field magnets.

There is a certain value of the field current—denoted on the diagram by the letter S—for which the armature current is a minimum; the power factor is then approximately unity, and the very small armature current passing into the windings is merely what is necessary to run the machine light. If, now, we imagine the field current to be reduced to a value indicated by the distance O M in fig. 1, the armature current will immediately rise to the corresponding value M N, and this will be *a lagging* current, the principal component of which is a magnetising current 90° behind the impressed E.M.F., because this will produce a field flux in the same direction as the direct current in the magnet coils, and its value will be such as to provide the magnetising ampere-turns which have been taken off the field coils.

If, on the other hand, we strengthen the field current, the main component of the armature current will *lead* the impressed E.M.F by 90°, and so counteract the magnetising force of the additional field ampere-turns.

For a given value, O P, of the field current, the no-load armature current may be of exactly the same value as when the field current was O M; but in the first case it will be *in advance* of the impressed E.M.F. by nearly a quarter period, while, in the latter case, it will *lag behind* the impressed E.M.F. by the same phase angle.

Now consider the vector diagram fig. 2. Here $\overline{O E}$ represents one phase of the impressed polyphase E.M.F., which is supposed to be of constant value. We shall not complicate the diagram by taking into account the step-down transformers, and the length O E must be considered as representing the primary pressure *reduced to the pressure at slip rings*, in accordance with the transformer ratios, for the condition of the correct field excitation, *i.e.*, when the field current is such as to make the power factor a maximum (O S in fig. 1). Under this condition the armature current is practically zero. Let us now see what will be the pressure at slip rings with a reduced field excitation, and, therefore, a lagging armature current, which may be represented by the vector $\overline{O N}$.*

Note first, that *if there were no self-induction in the circuit, the pressure across slip-rings would remain unaltered*, except for the small resistance drop, which may be neglected; but if the circuit has self-induction, the back E.M.F. due to the current $\overline{O N}$ will be $\overline{O e'}$, drawn exactly 90° behind $\overline{O N}$. The result will be that the pressure at slip-rings will be reduced to $\overline{O E'}$, which is less than O E by the amount O e'. Suppose now that the field current is increased until the armature current is a leading one of value O R; then $\overline{O e''}$ will be the induced E.M.F. due to this current, and it will be in phase with $\overline{O E}$. The pressure at slip-rings will therefore be $\overline{O E''}$, which is equal to O E + O e''.

We are now in a position to plot the dotted curve in fig. 1, showing how the pressure at slip-rings increases with increased field ampere-turns, and from this it is easy to understand that a rotary converter provided with a shunt winding across the brushes, and a series winding carrying the load current, may—by suitably adjusting the amount of self-induction—be made practically self-regulating at all loads.

It is important to bear in mind that, in order to obtain this result, the ohmic resistance of the cables, transformer windings, &c., must be low; and this is of still greater importance if it is desired to *over-compound* the rotaries.

If the distance of transmission is great, or the voltage so low as to involve a considerable drop of pressure in the cables, then this method of regulation is unsuitable. The chief objection to the compound winding of rotary converters, as above described, is that the power factor of the polyphase supply is continually changing, and this makes it difficult to maintain constant pressure at the receiving ends of the transmission lines. Mr. A. C. Eborall, in his paper on polyphase sub-station machinery,† states that, in practice, the self-induction in the polyphase leads, and the amount of the field excitation, would be so adjusted as to make the armature current at no load a lagging one equal to about 30 or 40 per cent. of the full load current. As the load comes on the machine, the power factor improves, and becomes nearly unity at half full load, after which, with a further increase of load (and, therefore, of field ampere-turns), the armature current would be in advance of the applied E.M.F.

SEPARATION OF OIL FROM FEED WATER.

By J. H. HARWOOD.

In all electric light and power stations and similar installations driven by steam power, the question of successfully eliminating the emulsified oil from the feed water is one which still seriously troubles the engineer, in spite of the various separating devices which are manufactured and warranted to cure the trouble.

It is certain that except in isolated cases, the ordinary exhaust steam separator consisting of a cylinder or drum filled with varying types of scrubbers or baffle plates is of very little use, except as a trap in which a small proportion of the free oil coming over with the steam is retained.

The theory upon which separators of this kind are constructed is that a sudden expansion of the steam into the separators causes a reduction in the surface tension, and thus renders the steam incapable of holding the oil, which should then be deposited upon the baffle plates or scrubbers. From these it can trickle down into the body of the separator,

* In this diagram (fig. 2) the current vectors are drawn exactly 90° out of phase with the pressure vector, although in practice this condition is never quite reached. But, with the machine running light, the phase angle will be very nearly 90°, and, in any case, even if the machine were loaded, it would be correct, for the purpose of this argument, to consider O N as the magnetising component of the total armature current, because the "work" component (in phase with O E), will produce only cross magnetising effects, and, even in the choking coils, will not give rise to a back E.M.F. having any appreciable effect on the regulation.

† "Some notes on Polyphase Sub-station Machinery," by A. C. Eborall, read before the Institution of Electrical Engineers March 14th, 1901.

hence it may be drawn off by means of a small pump applied for the purpose.

In the writer's experience all separators of this kind are practically inactive when working under a high vacuum, although they may abstract a small portion of the oil under a low vacuum. But this oil appears to be mainly free oil, not the oil which is present in the water in a finely emulsified condition, and which gives the water the milky opalescent appearance familiar to all engineers.

Water-jacketing the bodies of the separators has been suggested, and in one case within the writer's knowledge was tried, without any appreciable benefit.

In many separators the baffling devices have been made so complete as to cause a very serious difference of vacuum between the condenser and the low-pressure cylinder, and in a large power station recently the condensing plant contractors were unable to obtain the necessary results until the internal parts of the oil separator supplied under another contract had been removed.

It appears, then, that the ordinary exhaust steam separator, which is intended to remove the oil from the steam before it reaches the condenser, is—to put it mildly—unreliable, and this brings us to the next class of apparatus, which are usually termed by makers absolute oil-separating or water-purifying plant.

These may be roughly divided into two classes—those which effect the separation of the oil from the feed water by a discharge of electricity between plates immersed in the water, and those which mix a chemical coagulent with the water. In both types the final separation and purification is effected by some form of filter.

There appears to be a wide-spread belief that emulsified oil can be separated from water by filtration alone, but this is a mistake, for the oily water will pass practically unchanged through the finest filter made.

The reason is that the minute oily globules are so elastic that they will creep through any substance which will allow water to pass, and it is only by breaking up the globules and entangling them together in the form of a precipitate that any filter can be enabled to retain them.

In the system of electrical coagulation this is successfully accomplished by passing the oily water direct from the air pump through a series of wooden tanks, in which are numbers of iron plates placed fairly closely together and arranged in pairs connected to opposite poles. The current flows from plate to plate through the water, and the result is that some oil appears on the surface of the water, while the rest is entangled in a fine red deposit consisting of oil and iron particles which can be readily filtered out. The floating oil can, of course, be skimmed away, and should not be sent through the filter at all.

The amount of current necessary for the treatment appears to vary, but a general average comes out at about $1\frac{1}{2}$ units per 1,000 gallons of greasy water treated. There is also some waste from the iron plates which must be taken into account when estimating the cost of treatment by this method.

In electricity works where energy is cheap this method has many advantages and is becoming more extensively adopted, but in works where electricity must be bought most engineers prefer to use some form of chemical treatment. In nearly every case this means the use as a reagent of alumina ferric or cone alum, as it is termed by the chemical trade.

This is made into a solution of convenient strength, and is kept in a storage tank, from whence it is allowed to mingle in correct proportion with the water of condensation discharged by the air pump.

The quantity of reagent required is very small, amounting to an average of about 1 lb. of alumina ferric salt to 5,000 gallons of greasy water to be treated.

To obtain a satisfactory coagulation, it is necessary that there should be lime salts present in the water ; and as these are usually absent in water from surface condensers, it is usual in such cases to mix the make-up feed water with the greasy water at the same time as the alumina ferric solution is added.

After the mixture is effected the water must be allowed to remain in a reaction tank of suitable capacity before filtration can be commenced. This tank is usually large enough to give 30 minutes' reaction when the maximum amount is passing through the apparatus. By a suitable arrangement of baffle plates the water may be allowed to flow continuously in at one end of the tank and out at the other into the filter, the necessary reaction and coagulation having taken place meanwhile.

Of course, it is very necessary that the supply of reagent to the water should always remain in the same proportion, whether the flow of greasy water is large or small, and if the water stops the chemical supply should cease also.

This can be easily effected in several ways, the most obvious being by means of a float which rises and falls in proportion to the amount of greasy water flowing through, and small pin valves which rise and fall with the float, and so control the chemical supply or shut it off entirely when necessary.

But such arrangements have the disadvantage that the valves are of necessity very small, and any sediment, &c., which is unavoidable when dealing with a solution of alumina ferric, soon causes trouble by interfering with the correct action of the valves. Also when the amount of water flowing through is very small, as during the day-load on a lighting station, the valves must be so finely set that they become altogether too delicate a piece of mechanism to put into the hands of a stoker such as generally has charge of such plant as that under consideration.

In the writer's opinion a positive measuring apparatus is essential, and one without unnecessary moving parts such as tipping devices and the like.

The best means is probably a tank large enough to contain about five minutes' supply of greasy water, which flows directly into it. Arranged by the side of this tank are two little tanks filled with alumina ferric solution and hard make-up feed water respectively—the solutions being controlled by ball-cocks from storage cisterns.

In the larger tank is a large siphon set to break when the tank is nearly full, and arranged to deliver the contents quickly into the reaction tank beneath. The action of the siphon is at the same time taken advantage of to raise valves in the bottom of the two auxiliary chemical and hard water tanks, and to cause their contents to mix with the greasy water on its way to the reaction tank.

In this way a measured quantity of chemical and hard water is always mixed with another positive quantity of greasy water, and the proportion of chemical delivered to the water cannot, under any circumstances, be other than correct. Equality of chemical treatment under all conditions of load is ensured, and there are very few moving parts to become corroded or rendered inactive through deposit, &c.

One slight drawback to the use of alumina ferric is that it gives an acid reaction, and great care is necessary that the quantity used is not in excess of that necessary for coagulation, or the water in the boilers may become decidedly acid and therefore corrosive. But if the treatment is carefully determined beforehand and the water occasionally tested with litmus, this method seems to work out satisfactorily in practice, and in the event of a larger quantity of alumina ferric than usual being necessary, owing to soft make-up feed water or other causes, a little soda ash solution can always be supplied to the reaction tank to neutralise any acidity set up by the alum. Some manufacturers of oil-separating appliances of this type supply a small soda tank and mixing arrangement for this especial purpose.

The cost of this chemical treatment is considerably less than for the electrical treatment first described, the actual cost for chemicals used working out to about $\frac{1}{8}$d. per 1,000 gallons of greasy water treated. The amount of attention required by the apparatus is, however, slightly more, as the chemical storage tank must be replenished every day ; but as this can easily be done in half an hour, the cost is not serious.

The success of either of the above methods of treatment depends ultimately on the method of filtration employed. And it may be said here that the only filtering medium which has given any real satisfaction to users is fine quartz sand used in a filter of the open or gravity type. All sorts of media have been tried, from coke to sponge and wood-wool, and while some will answer fairly well for an hour or two, none can continue doing their work for any length of time without cleansing. This is an extremely messy and

tedious operation, and the most successful filters at present operating are of the quartz sand type, of very ample filtering area, and fitted with some sort of return flushing arrangement either automatically or hand operated. The area of the sand bed should in no case be less than 7 sq. ft. per 1,000 gallons per hour of water passed through, and with this capacity washing is necessary every four or five hours in ordinary cases when working under full load.

The washing is effected by closing the inlet and outlet valves on the filter and then allowing a large quantity of clean water either from mains or from a tank overhead to flow upwards through the sand bed. This water should be discharged in such a way as to trap the air lying in the bottom of the filter and drive it in front of it through the sand, thereby thoroughly disturbing the sand and allowing the cleansing water to wash the fine particles and carry off the silt adhering to them.

Suitable means are adopted to prevent the sand being carried away along with the water, which overflows a channel in the upper part of the filter and escapes to the drains.

In one form of filter on the market this entire cycle of operations is performed by the filter itself automatically as often as required, and most successful grease-separating installations are at present provided with this form of filter.

The great drawback to hand-washing lies in the fact that a considerable amount of attention is necessary to ensure the washing being carried out at the right time and in a thorough manner.

With any type of sand filter it is of great importance that the oily film floating on the top of the water in the filter should not come into contact with the sand, or it will adhere to it and clog it at once, and the only remedy is to scrape off the top of the sand bed itself, as ordinary washing does not remove it.

The filter should be fitted with a valve controlled by a float, which prevents the water ever leaving the bed dry, and if this is in good working order no trouble will be experienced on this score.

It must be said, however, that even the best filters at present on the market are not perfect when dealing with oily deposit, and the writer hopes that before long some other means of separating the coagulated matter may be devised, thus avoiding a great deal of the trouble and anxiety constantly experienced by engineers who have the responsibility of a large battery of high-pressure boilers fed with water from surface condensers.

STERILISING WATER BY MEANS OF OZONE.*

Messrs. Siemens & Halske, recognising the value of ozone as a sterilising agent, have recently turned their attention to the design of compact portable and stationary installations, for use in hospitals and private institutions, and also for military purposes. The general arrangement of some of these will be seen from the accompanying illustrations. The principle on which they work is that of the generation of ozone by means of high-tension electrical discharges, the ozone being then blown through a long tube (called the tower) filled with nodules of porcelain, or flints into which at the same time water is pumped from the best source available. The water is passed through a preliminary filter to rid it of coarse impurities. Either alternating or interrupted continuous current is used.

In the types illustrated the current is alternating. In fig. 1 is shown a small stationary apparatus made in sizes suitable for sterilising from 200 to 670 gallons of water per hour. This type is in use in St. Petersburg for sterilising drinking water, in Astrachan for mineral water, and in a large brewery in Munich.

Going from right to left of the picture, we have (1) a sterilisation tower filled with flints. The ozone enters by the siphon-like tube on the left side of the pipe tower, and leaves by the small pipe at the top on the right hand. Water enters through the large pipe at the top, and leaves at the foot, as shown. It is thus aerated with ozone in passing through the tower. (2) On the floor is a direct-current motor direct coupled to an alternator, and also driving by belt or gearing a blower and a pump. (3) Above is a cupboard containing the ozone-making apparatus, which consists of eight glass tubes with inner conductors of aluminium, water-cooled and fed from a transformer. On the outside is a meter and switch for the primary of the transformer. (4) On the left is a switchboard with main switch, voltmeter, fuses, and, below it, a starting resistance for the motor and regulating resistance for the exciting current of the alternator. The pipe with two branches beneath the cupboard is for air.

Installations of this type are furnished with automatic apparatus to cut off the flow of unsterilised water to the tower if the transformer secondary current fails, or if the pressure of the supply of ozone to the tower drops below a previously determined limit. The air-blower or fan draws the air from a filter. The water-pump supplies the crude water to the tower.

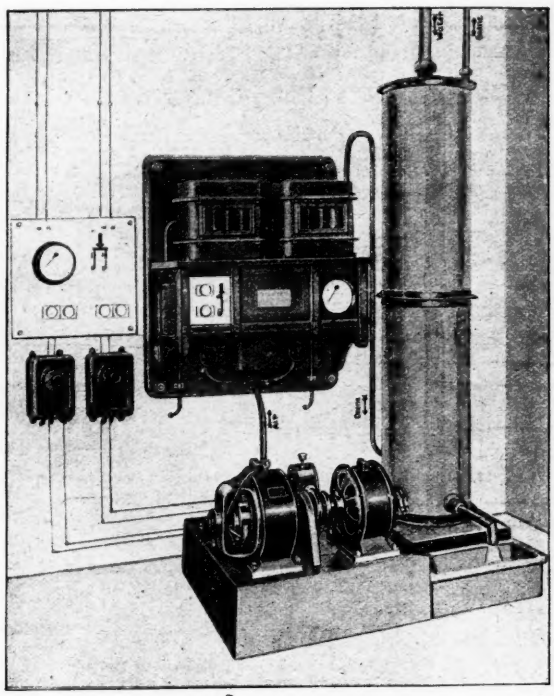


Fig. 1.—Typical Installation for Sterilising Water for Outputs up to 670 Gallons per Hour.

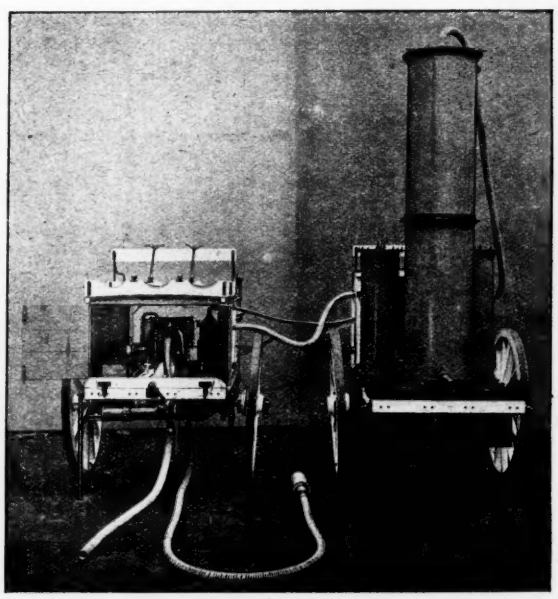


Fig. 2.—Portable Outfit for Sterilising Drinking Water for Army Use; Arranged as in Use.

The portable installation for use on the field in military operations is illustrated in figs. 2 and 3.

Two installations of this type were actually used by the Russians in Manchuria. The various parts of the installation are arranged on two wagons, one of which takes all the moving machinery, and

* From an article by Dr. G. Erlwein in *Gesundheit*.

the other the actual sterilising apparatus. On the machinery wagon is mounted:—(1) A petrol motor of the type generally applied to automobile driving. (2) An alternator with small exciter-dynamo on the same shaft, supplying low-tension current to the transformer. (3) A small centrifugal pump, driven by belting from the dynamo shaft, by which the unsterilised water is pumped up to the tower through coarse filters. (4) A small blower or fan, which gently impels the air through a calcium chloride filter (on the machinery wagon) and thence through the ozonisers to the tower, which it enters at the base. (5) Two chests containing spare tubes and spare parts for the motor.

The apparatus wagon is provided with: (1) Two ozonisers (one as a reserve), each fitted with eight ozone tubes mounted on a cushioned base. (2) Under the cart the transformer, which is connected by cable to the alternator on the other wagon. (3). The coarse filters for water connected in parallel, and consisting of sheet metal cylinders in which are placed closed filter bags. (4) The tower of

Fig. 3.—Portable Outfit for Sterilising Drinking Water for Army Use; Packed for Transport.

sheet-iron, 6 ft. 6 in. high, having a cross-sectional area of 2 sq. ft., *i.e.*, 1 ft. 6 in. in diameter, which is fitted in this case with gravel of the size of a pigeon's egg, or cement-covered pumice stone. This tower is in two parts, with perforated false bottoms, and is so arranged as to lie horizontally when packed. This wagon has also five chests for tools and spares.

In fig. 2 the thick tubes on the ground are the water suction and motor exhaust; the thick tubes between the wagons, the water delivery to the filters; the thinner tube, the air delivery to the ozonisers; the electrical conductor being easily distinguished.

Fig. 3 shows the wagons packed ready for transit. The tower is laid in two parts on the apparatus wagon, which is ahead, and the three coarse filters are taken on the machinery wagon. Each wagon is provided with shafts, and weighs loaded about 1,980 lb. This installation is suited for an output of 120 to 200 gallons per hour, and requires about 2 H.P. for this output. Water cooling of the ozone is not employed in these types.

The installation shown in the figures was tested before being sent to Russia, by Prof. Proskaner, with water from the Spree, and its bactericidal effect verified. In St. Petersburg it was again tried with Neva water rich in bacteria. One outfit was finally sent to Harbin, and the other to Vladivostock. The Harbin one was worked from eight to ten hours daily.

According to curves shown of this apparatus, the grammes of ozone produced per hour can run up to 30; the cubic metres of air drawn in up to 35, the yield of ozone per cubic metre falling steadily until, when at 30, it is only ·85 per cubic metre, the grammes ozone per horse-power-hour rising to 47. The best result appears to be attained with an output of 15 grammes per hour, when the concentration is 3·6 and the grammes per electrical horse-power ·28. The aim in working is naturally to get a good quantity of ozone into the air stream, without unduly diminishing the yield in grammes per electrical horse-power-hour.

Ganz & Co.—It is announced from Buda-Pesth that the directors of Messrs. Ganz & Co. have decided to recommend at the forthcoming meeting of the shareholders, the transformation of the electrical engineering department into an independent company, the majority of the shares in which would be retained by the parent concern. A further portion of the shares would be taken over by the group associated with the Vienna Allgemeine-Union Co., which is connected with the Berlin Allgemeine Co. It is proposed to establish a community of interests between the new company and the Vienna Union Co., and Ganz & Co. will take up a block of the new shares to be issued by the Union Co. By means of agreements, Ganz & Co. and the new electrical company, which will have a share capital of £330,000, will enter the international concern, composed of the Berlin Allgemeine Co. and the General Electric Co. of New York.

THE NEWCASTLE ELECTRICAL EXHIBITION.

(*Continued from page 547.*)

Messrs. Falconar, Cross & Co., 4, St. Nicholas Buildings, Newcastle-on-Tyne.—This firm has a large showing of electric lamps, fittings and accessories, among them being mercury vapour, tantalum and "Osmi" lamps, ship lighting fittings, McGeoch's ship's light indicator, various electroliers, brackets and other private lighting fittings of Messrs. Best & Lloyd's manufacture. Methods of power and lighting wiring, direct and three-phase motors, improved motor-starters, Westinghouse induction motors, capstan switches, motor fans and blowers, Prometheus radiators and cooking appliances, Siemens's "Vilex" water-tight mining bells, and so on, are all in evidence. In connection with this stand,

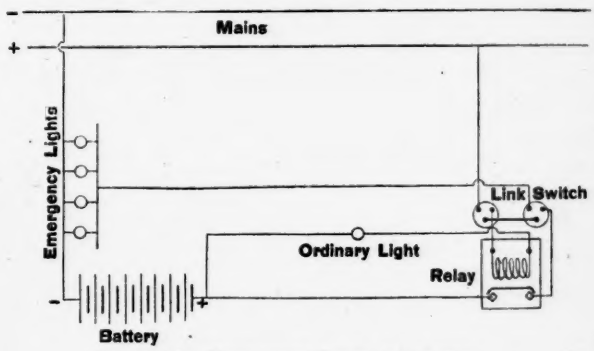
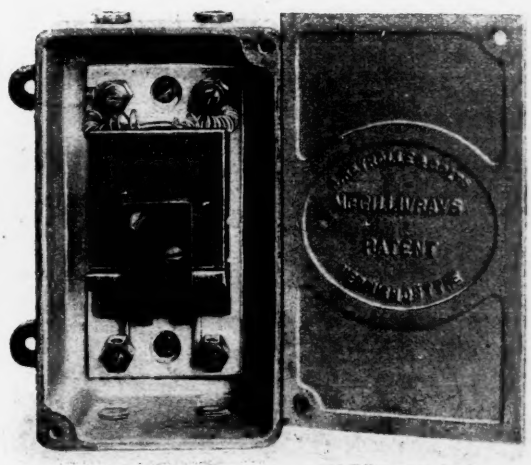


Diagram of Emergency Light Apparatus.

there is also run another exhibit a little distance off, by the Synchronome Co., for whom Messrs. Falconar, Cross & Co. are agents. Here the Hope-Jones electrical time service, embodying the most recent improvements in the system, is well represented. Messrs. Falconar-Cross have carried out a large number of important power and lighting installations in the north-eastern district, amounting in all to upwards of 2,000 H.P. and over 30,000 lights. These include the North-Eastern Marine Engineering Co.'s Works at Wallsend, the Consett Iron Co.'s new coke ovens and various shipyards, mines, &c.

We noted a patent emergency light apparatus on this stand and also elsewhere in the Exhibition. It is the invention of Mr. H. McGillivray, the outdoor superintendent of the Newcastle and District Electric Lighting Co., Ltd., and among other places for which it is being adopted is the operating theatre at the new Royal Infirmary at Newcastle. It is also in service on the Central London Railway trains, and in several electric power stations, theatres, on tramways, &c. In the case of a tramway



McGillivray Emergency Light Apparatus.

the apparatus switches on emergency lights in the car automatically when the line current fails or the trolley slips the wire. The arrangement will be very useful at the termini when shifting the trolley. In the accompanying figures we show the apparatus and the manner in which it is connected. Very little room is occupied by the battery and automatic switch which form the apparatus. Charged automatically from the ordinary circuit, in series with the lamps, the battery in its turn supplies current to the emergency lamps. By the use of a double switch it becomes impossible for the attendant to put on his ordinary lighting circuit without also connecting up the emergency circuit.

E

Messrs. Flitton & Coombs, Caroline Street, Old Kent Road, S.E.—This firm shows on the stand of the Newcastle and District Electric Lighting Co. Middleton's patent terminals or couplings for electric cables, for which it is claimed that with their use the connections remain constantly tight, and that they are particularly safe when used with electro-magnetic apparatus,

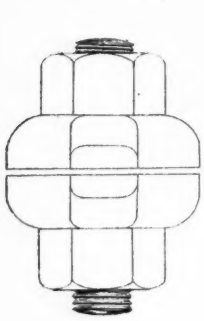


Fig. 2.

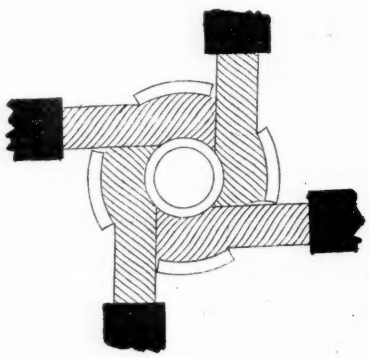
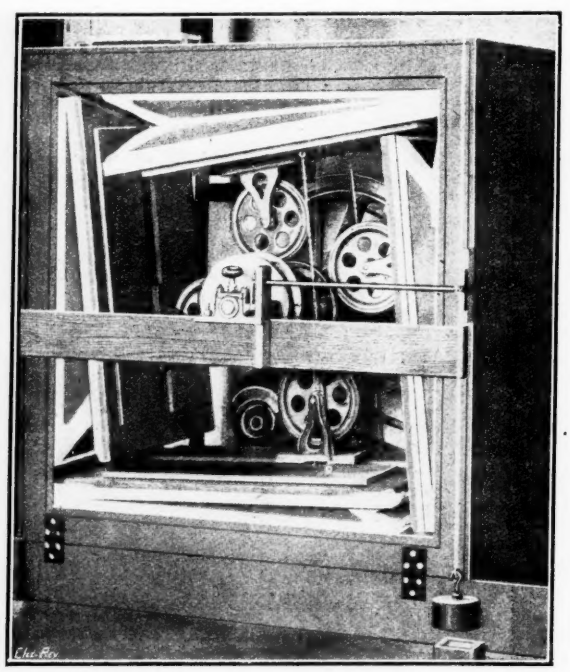


Fig. 1.

and where a slack connection might cause a breakdown. The firm stocks a line of insulators for use with the couplings which enables them to be used in confined places. The combined coupling and insulator forms a perfect joint (mechanically and electrically) for conduit junction boxes. Fig. 1 shows a four-way coupling, and it will be seen that there is no bending of wires needed. Fig. 2 shows the complete terminal. Each size has been designed to give ample contact surface when the full number of cables are in position.

Messrs. Robson & Coleman, St. Mary's Place, Newcastle-on-Tyne.—The new "Excello" white flame lamp of the Union Electric Co. is to be seen here; indeed, these lamps are used for lighting outside of the Exhibition building, and part of the interior lighting, as well as for the street approaching the Exhibition, as mentioned in last week's Electrical Review. Messrs. Veritys' Aston enclosed arc lamps are shown, burning five in series on 480 volts without cut-outs and substitutional resistances; also the Aston twin carbon lamp, burning direct on 240 volts, miniature arcs, Nernst and Cooper-Hewitt mercury vapour lamps. A No. 1



Blackett & Howden's Wind Generator for Organ Blowing.

Runway crane for warehouse and other use is driven by a Verity motor; and there is a range of motors from ¼ to 10 h.p., an electric hand-drill, motor-driven sewing machine, also radiators, cooking appliances, meters, and many accessorial details. The stand itself is outlined in screwed welded tubing, and its outstanding feature is Blackett and Howden's patent wind generator for organ blowing, which we illustrate; this is direct coupled to a 2-h.p. Aston motor and worm gear, and as already mentioned, it is employed to supply wind to the organ on the stand of the Newcastle-on-Tyne Supply Co. from which it is controlled.

Messrs. Crosier, Stephens & Co., 2, Collingwood Street, Newcastle-on-Tyne.—Several well-known manufacturers are represented at the set of stands controlled by this firm. Messrs. Crosier, Stephens are agents for, among others, Messrs. E. Green & Son, Ltd., of Wakefield and Manchester, and, therefore, they exhibit a number of illustrations and plans of the well known Green economiser, also photographs of some large installations thereof in electric light and power stations. One of the views is of Chelsea (Lot's Road) power station, where the economisers have 9,216 tubes, another being the Neasden station of the Metropolitan Railway, where the installation comprises 1,760 tubes. The seamless, welded and ordinary steel electric wiring conduits made by the New Brotherton Tube Co., Ltd., of Wolverhampton, are also represented here. The steam specialities of Messrs. Holden & Brooke, Ltd., of Manchester, are prominently set out. They comprise Brooke's "high velocity" exhaust steam feed water heater, shown in section; a section model of Green's patent stop and control valve, which is especially suitable for turbine and power station work, marine, colliery and rolling mill engines; a section model of Brooke's patent "protected seat" stop valve; also Leinert's water meter, which accurately measures (and automatically records such measurements on a counter) water or other liquids by weight. Further, there will be observed Brooke's patent oil separator to which is attached one of the maker's dischargers which automatically discharges the oil and water abstracted by the separator from exhaust steam. The motion of this discharger can be seen, for instead of the ordinary cast-iron casing, it appears working inside a glass cylinder. Other Holden & Brooke specialities exhibited include automatic stopping and starting gear for water lifters and pumps; circulators for heating and circulating water, &c. Kennedy's tube-bending machine, a motor-driven planing machine, portable electric drilling machine, portable electric rock drill, the Jeffrey "Chain-header" coal-cutting machine, the Davis anemometer and mechanical wages calculator, joint-making apparatus, the Hyatt roller bearings, also specimens of aluminium conductors and joints and Acheson graphite, all have a place.

Sunderland Forge and Engineering Co., Ltd., Pallion, Sunderland.—This company is to be congratulated upon the enterprising spirit it has displayed in bringing together such an excellent collection of electrically-driven machinery for shipyard, mining and other purposes. The exhibits are made up of their standard lines of manufactures, and include an electrically-driven centrifugal pump, shipyard winch, portable electric saw bench, also a crab for a four-motor electric crane, while there are further three of their combined plants for ship lighting, a complete induction motor and parts thereof, also other motors and dynamo armatures. The engineers and others engaged in the shipbuilding and other great industries of the locality have been finding an inspection of this impressive exhibit very much to their liking, and to their own and the Sunderland Forge Co.'s advantage. We gathered from a conversation with Mr. Reid, the firm's very energetic outside manager, that the works are so full up with orders, that day and night shifts are running continuously, and the growth of business has necessitated extensions to the works which are now being proceeded with.

Reason Manufacturing Co., Ltd., Brighton.—This firm has an imposing display of electric street lighting fittings, brackets and standards; also three types of Reason arc lamps—twin-carbon, series and miniature—fuse and joint boxes, demand indicators (both thermal and magnetic types), and various meters. The most recently introduced thing shown is the company's new solution meter.

Messrs. H. T. Boothroyd, Hyslop & Co., Primrose Works, Akenside Street, Bootle.—A direct-coupled generator for ship lighting, electric motors, ship lighting fittings, switchboards, and a portable electric-drilling apparatus comprising motor, telescopic shaft and patent drill head, are being exhibited by this firm.

The Brush Electrical Engineering Co., Ltd., Lambeth, S.E., and Loughborough.—The two chief items on this stand are intended to appeal to marine and mining men in which this part of the country abounds. The Birtley-Falconer direct current electric coal-cutting machine, as displayed at Olympia last year, is shown working, and mining engineers and managers who may be visiting the exhibition will not be likely to pass by on the other side. Of marine interest is the Brush-Holland-Johnston coal elevator which the company is just now introducing. It is a portable type specially adapted for coasting colliers, and when not in use it is placed on top of the cargo in the hold, or carried on deck. It is also applicable for shore installations, a direction in which either steam or electric driving may be employed.

Messrs. W. Lucy & Co., Ltd., Eagle Ironworks, Oxford.—That ingenious little instrument which was shown at Olympia—Frahm's speed indicator, frequency teller and revolution counter—is shown with its inner self laid bare to view for the instruction of those interested. A description of this instrument has already appeared in the Electrical Review. There are also exhibited time switches for special power rates, fuse and service boxes, and castings for electrical purposes.

Messrs. Mavor & Coulson, Mile End, Glasgow.—The "Pick-Quick" electrical three-phase coal-cutter is arranged on this stand, and there is also an exhibit of a "Longwall" coal-cutter specially designed for thin seams.

(To be continued.)

LEGAL.

Swansea Corporation *v.* The National Telephone Co.

This case came before Lords Justices Vaughan-Williams, Stirling and Cozens-Hardy in the Court of Appeal on Wednesday last week, when the report of Major Cardew, R.E., who was appointed by the Court to ascertain the requirements for intercommunication between the Corporation and the company's telephone systems in Swansea, was read and considered.

Mr. Buckmaster, K.C., and Mr. R. J. Parker, appeared for the Corporation, and Mr. Astbury, K.C., and Mr. Dankwerts, K.C., for the defendant company.

Mr. Buckmaster, K.C., stated that the report was one which had been ordered by the Court, and with which the Corporation had nothing whatever to do. They found themselves in some difficulty in dealing with this report, unless they could ask Major Cardew a series of questions arising out of the answers given. He was not entitled to, in any way, interfere with the report, and he made this statement in order that the Court might not think the Corporation passed it without comment. The question was as to what were the proper facilities that were to be given for intercommunication. The first question the Court asked Major Cardew was—"Whether in order to afford all proper facilities for the transmission of telephone messages between persons using the system of the Telephone Co. in the Swansea Exchange area and persons using the system of the Corporation in the same area, and between persons using the latter system and persons using the former system, junction wires in sufficient numbers should be laid between all or some and which of the company's exchanges, and all or some and which of the Corporation's exchanges, and whether such junction wires should be one-way wires—that is to say, one set to be used for calls from the company's subscribers to the Corporation's subscribers and a corresponding set to be used for calls from the latter subscribers to the former, and whether such junctions should be enclosed in cables in sets, or how otherwise." Major Cardew reported:—"As it is now common practice that all telephonic circuits should consist of a line and a return wire in place of using, as was formerly customary, a single-line wire and completing the current by means of the earth, I have in my answers used the term junction circuit, which must be understood to include two wires properly erected and connected. Junction circuits should be laid between the Corporation's exchanges and the company's exchanges as follows:—Between Corporation exchange at Swansea and company's exchange at Sketty, one junction circuit; Gorseinon, two junction circuits. Between Corporation's exchange at Morriston and company's exchange at Clydach, one junction circuit; Pontardawe, one junction circuit. These junction circuits should be all one-way junctions, to be for calls from the Corporation's subscribers. They may be either enclosed in cables in sets or erected overhead, or partly in one way partly in the other."

Mr. Buckmaster submitted that it was quite clear the language in that answer wanted considerable modification in order that it might be understood. The second question was:—

"Whether the laying down of sufficient junction wires between the several exchanges of the Corporation and company respectively at (1) Swansea; (2) Mumbles; and (3) Morriston will afford all such proper facilities as aforesaid."

The answer was:—

"No further facilities will be required to provide for what may reasonably be expected as regards intercommunication."

Question three ran:—

"Whether in order that all such proper facilities as aforesaid should be afforded, it is necessary that there should be provided junction circuits to directly connect the Corporation's principal exchange in Swansea with each of the following exchanges of the company, namely, Swansea, Blackpile, Forestfach, Pontardulais, Portardawe, Sketty, Killay, Gorseinon, Clydach and Lansamlet, or any and which of such places."

The answer was:—

"At present junction circuits should be provided to directly connect the Corporation's principal exchange in Swansea with each of the following exchanges of the company, viz., Sketty, Gorseinon. Additional junction circuits to other exchanges may be required later when the traffic has sufficiently increased."

Mr. Buckmaster said he attached great importance to that answer, because the judgment appealed from involved the very question as to coming back to the Court when the traffic had sufficiently increased to require further communications, such as those the learned judge directed.

The fourth question was—

"Whether any and what additional, or other, steps ought to be taken by the Corporation and company respectively in order that each of the parties concerned should afford all such proper facilities as aforesaid."

Answer—

"(*a*) The Corporation should make such arrangements at Morriston as will best provide for calls from their subscribers to Clydach and Pontardawe by the junction circuits to be provided and their existing junction circuits to Morriston.

"(*b*) The junction circuits to be provided may pass through the company's exchanges at Swansea and Morriston respectively, but should not be brought to the switchboard in those exchanges for operating purposes.

"(*c*) Besides the junction circuits specified above which should be laid at once, additional junction circuits should be provided as and when required by the traffic, as follows: When the number of calls in any one hour from subscribers on the Corporation's system to an exchange on the company's system, not at present to be connected directly with the Corporation's system, has exceeded five on three or more occasions in one month, a direct junction circuit should be provided from one Corporation exchange to the company's exchange, and by this circuit the calls should be transmitted from the Corporation's system to the company's exchange.

"(*d*) Similarly, when the number of calls in any one hour from subscribers on the company's system to an exchange on the Corporation's system has exceeded the same limit, a direct junction circuit should be provided from one company's exchange to the Corporation's exchange, and by this circuit the calls should be transmitted from the company's system to this exchange of the Corporation.

"(*e*) From and after the time when one or more junction circuits have been provided for the purpose of transmitting calls from the Corporation's system to any exchange on the company's system, or from the company's system to any exchange on the Corporation's system, all such calls should be so transmitted and these junction circuits should be added to as may be required to provide adequately for this service. Should the above answers appear in any way incomplete, or should further information be required, I am entirely at your Lordships' disposal.—P. Cardew."

Mr. Buckmaster, proceeding, said it was no part of his duty to re-argue the case, which had already been heard at great length. Taking the report in the most unfavourable manner to his contention, it did not defeat the position which the Corporation took up before Mr. Justice Buckley, and which they had maintained in the Court of Appeal. The question was as to whether what the company demanded was right and reasonable. The company demanded that the Corporation should lay wires from the central exchange to all the company's sub-exchanges with which intercommunication was necessary. The answer to that was: "No. Our system has been constructed so that when intercommunication takes place our system is efficient, and will take the whole of the extra traffic without further wires having to be laid down." The report of Major Cardew justified everything the Corporation said. The company must make their system efficient for transmitting the Corporation messages, as the Corporation's system was efficient for transmitting the company's messages.

Lord Justice Vaughan-Williams: Having regard to the state of things arrived at, which resulted in these questions being put to Major Cardew, and his report in answer: our duty is now to determine what, as a matter of fact, ought to be done. Your observations do not deal with that, but deal with who was right or who was wrong at the time the action was brought. We hope to dispose of the case this term.

Mr. Astbury, K.C., for the company, said they took an entirely different view of the report. He reminded their Lordships as to the nature of the dispute, and submitted that their contention had been completely affirmed by Major Cardew's report. His learned friend on the other side had not in the least appreciated what Major Cardew had directed. Major Cardew's report was a complete acceptance of the view put forward by the company. He absolutely disagreed from the judgment in the Court below.

Mr. Danckwerts reminded their Lordships of his arguments when the case was last before them, and said it entirely coincided with Major Cardew's report.

Lord Justice Vaughan-Williams: I think we understand your arguments. We are anxious if we can to deliver judgment this sittings.

Sanders *v.* King.

At Wednesbury on 3rd inst. Messrs. William Sanders & Co., electrical fittings manufacturers, sued Frank King, switchboard maker, Ellesmere Road, Saltley, Birmingham, for £2 10s. damages for leaving his work without notice. A report in the *Birmingham Daily Post* states that the case for the plaintiffs was that defendant was engaged on a distinct stipulation that the term of notice should be seven days, but defendant absented himself on January 19th, and was afterwards found to be working for another firm at Aston. The defence was that nothing was said as to the notice, and that it was a custom of the electrical trade for workmen to leave either at a minute's or an hour's notice. The stipendiary (Mr. Neville) accepted the evidence given by the plaintiffs as to notice, and gave a verdict for plaintiffs for 32s. and costs.

Smith & Co., Ltd., *v.* Llandudno and Colwyn Electric Traction Co., Ltd., and others.

The above case, the hearing of which has been postponed several times with a view to a settlement being arrived at, was down for trial before Mr. Justice Lawrance in the King's Bench Division on Saturday.

Mr. Hugh Fraser appeared for the plaintiffs, and Mr. Langdon, K.C., and Mr. Leck for the defendants.

Mr. Langdon announced that the parties had now come to terms. A judge's order would be asked for if necessary.

Motor-'Bus and Tramcar Collision Claim.

On 5th inst. a special jury (Mr. Justice Grantham's Court) found against both the London Road Car Co. and the London United Tramway Co., Ltd., awarding £250 and £100 respectively to Mr. and Mrs. Walters in respect of injuries sustained by them in a motor-'bus and tramcar collision which occurred in the Goldhawk Road.

Clarke v. Hutton.

At the Marylebone County Court, before Sir Wm. Selfe, on Wednesday last week, Messrs. Oliver Clarke & Co., electrical engineers, of 24, St. Mark's Road, North Kensington, sought to recover from Messrs. J. E. Hutton, Ltd., automobile engineers, of Shaftesbury Avenue, £12 odd, said to be due as balance of account rendered for electric light installation at the Olympia motor show. Mr. W. J. Ball, plaintiffs' counsel, said that about the middle of October, 1905, plaintiffs entered into a contract to supply a large number of arc and other lamps, and to have them ready two clear days before the show opened on November 17th. Shortly before that time, however, defendants found they were not satisfied with the amount of light thrown on their exhibit, and ordered a further supply of arc lamps from plaintiffs, who were then almost ready with their work. This alteration had made a re-arrangement of the work absolutely necessary, and had made it impossible to comply with the contract. When the Bill was presented, defendants had deducted a certain amount which they deemed they had suffered through the lamps not being ready, and it was in respect of that amount that the present claim had been entered. Mr. C. O. Clarke said the lamps were actually lighted on the Friday evening after the opening of the show. No promise had been made to get the work finished after the fresh supply of lamps was ordered. Mr. Thornborough, who had charge of the lighting of the show, produced a book in which he had made an entry showing that the light was on at defendants' stall on the Friday. But in spite of this, Mr. John Ernest Hutton, managing director to the defendants, swore that it was not, and called a salesman to support his story. Mr. Hutton added that he had been charged for the lamps by the company which supplied the current, whether he had it or not. He had again and again complained of the light. The foreman had promised that the new lamps should make no difference.

His Honour gave judgment for plaintiffs for £10 odd and costs.

PARLIAMENTARY.

Accidents from Mechanically-Driven Vehicles.—Replying to Mr. T. Davies in the Parliamentary Papers as to the number of deaths caused by motor and other mechanically-driven vehicles in 1903 and 1904, Mr. Herbert Gladstone gives the following figures for England and Wales:—Motor-cars (1903), 39 persons; (1904), 59 persons; motor cycles (1903), 13 persons; (1904), 16; motor-omnibuses (1903), nil; (1904), 2; electric tramcars (1903), 64; (1904), 55; steam trams (1903), 1; (1904), 2; traction engines (1903), 19; (1904), 29; motor drays and wagons, (1903), 1; (1904), 9; steam rollers (1903), 4; (1904), 5.

Accidents on the Metropolitan District Railway.—In Friday's Parliamentary Papers, Mr. Hudson asked the President of the Board of Trade in how many cases on the Metropolitan District Railway had the axles of vehicles in use on trains for the conveyance of passengers broken since the commencement of electric traction power; had any inquiries been held into the cause of the failure of such axles; and could he say what was the cause of the breakages. —Mr. Lloyd George, in reply, stated that eight cases had been reported to the Board of Trade of broken axles of vehicles running on electrically-worked trains on the railway in question. An inspecting officer of railways had been appointed to hold an inquiry into the matter.

Second Readings.—In the House of Commons on 4th inst., the Twickenham and Teddington Electric Supply Bill was read a second time.

In the House of Lords last Friday the Wireless Telegraphy Bill was read a second time.

Candidates for the Consular Service.—In the House of Commons on 6th inst., it was stated by Sir E. Grey that at the next examination for the General Consular Service a proportion of the vacancies will be reserved for competition amongst candidates who have had actual commercial experience.

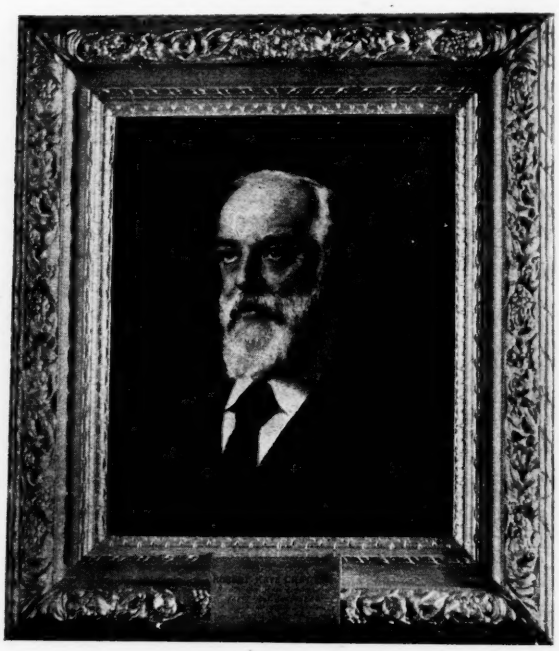
The Bankruptcy Laws.—The President of the Board of Trade has appointed a Committee to inquire into and report upon the effect of the laws in force in the United Kingdom in relation to bankruptcy, deeds of arrangement and compositions by insolvent debtors with their creditors, and the prevention and punishment of frauds by debtors on their creditors. The Committee are to report specially as to the desirability of amending the provisions of the Bankruptcy Law; also as to the desirability of requiring certain classes of securities which are now exempt from registration to be registered.

Post Office Telegraph Staff.—Replying in the Parliamentary Papers to Mr. Strauss who asked if a return will be given of the number of the telegraph staff of the Post Office who have obtained the additional increment granted for certificates of technical ability since its institution in 1897, the Postmaster-General stated that during the last five years 945 additional increments for technical (telegraph) qualifications have been granted.

PRESENTATION TO MR. R. KAYE GRAY.

At the meeting of the Institution of Electrical Engineers held on the 5th inst., the President, Mr. John Gavey, C.B., in introducing the business of the evening, intimated that the proceedings would commence with a presentation to Mr. R. Kaye Gray, Past President, and called upon:

Sir Joseph Swan, who said that it would be within the recollection of members that Mr. Gray's tenure of the presidency was marked by exceptional features, involving an unusual amount of labour and including lengthy tenure of office, due among other things to the death of Mr. McMillan, the late secretary. He thought, however, that all would agree that his period of office was most marked by the visit to this country of the Foreign Telegraph Engineers, to the International Conference, held in London, whom Mr. Gray, largely on behalf of the Institution, had munificently entertained, together with many of his fellow members. The desire arose to commemorate the event, and a Committee of the Institution was formed, with Mr. W. H. Patchell as secretary. They had induced Mr. Gray to give the necessary sittings for a portrait of himself, which had been painted by Miss Beatrice Bright, daughter of the late Sir Charles Bright. On behalf of the subscribers and Institution he asked Mr. Gray's acceptance of a portrait of himself and of a duplicate for the Institution.



Mr. Robert Kaye Gray, in acknowledging the gift, thanked the members for their kind thoughts, and referred to his pleasure in knowing that the artist was the daughter of his old friend Sir Charles Bright.

The President proposed a vote of thanks to the chairman (Sir Joseph Swan), secretary and members of the presentation committee, which was briefly responded to.

The portraits which were splendidly modelled and executed in oils, were also handsomely framed, a tablet inscribed as follows:—"Presented to Robert Kaye Gray, Esq., by Members of the Institution of Electrical Engineers, in recognition of special services rendered by him while President, 1904-1905," forming a portion of the frame. Through the courtesy of the Institution, we were enabled to photograph one of the pictures, which is reproduced above.

It is only fair to those who contributed, as to those who were not invited to do so, to say that the invitation was addressed to Members only, as distinct from Associate Members, Associates and Students. We regret that the occasion was not embraced for an expression of admiration and respect by the Institution as a whole, instead of one important section only.

PROCEEDINGS OF INSTITUTIONS.

The Use of Electricity in Mines.

"No industry calls for the transmission of power to greater distances, and under more disadvantageous conditions, and no class of work exposes the machinery to rougher or more onerous usage than the mining industry," says Mr. R. G. Mercer in a paper read before the Birmingham and District Electric Club on March 10th. "For these reasons steam, compressed air, and mechanical transmission are being rapidly superseded by electrical methods, which, besides giving increased reliability and freedom from breakdown, have been proved to be considerably more efficient and convenient, and to reduce working expenses correspondingly. The extent to which the advantages of electrical driving may be obtained depends very largely upon the quality of the plant, and the manner in which it is installed. Considerable and *specialised experience* must be brought to bear on each individual case, and to reduce the costs of mining and up-keep it is necessary that all machinery should be of the *strongest and most efficient construction and suited specially* for the work it has to perform." The italics are ours, and we hope Mr. Mercer impressed these points upon his audience. He might have added that this specialised experience can only be obtained by employment at a colliery. Mr. Mercer deals generally with electric winding, haulage, pumping, and coal cutting. With regard to winding, he says: "The most modern steam plant, even when fitted with automatic expansion gear and exhausting into a condenser, cannot compare with an electric winding plant from an economical point of view." We suppose the author means from a consumption of fuel point of view, which does not concern the colliery so much as capital expenditure, and on this point electrical winding would appear to less advantage.

Fully half the section on haulage deals with electric locomotives; though these may be quite satisfactory and suitable for the conditions in America, it is very unlikely that they will ever be adopted in this country. In speaking of main and tail haulage, the author says, "With the main and tail system two drums may be connected to a reversing motor or to two separate motors." Surely there is some mistake here; but if not, it may be news to Mr. Mercer to learn that the motor—and *only one* motor is required—always runs in the same direction, and does not require to be reversed; also one drum is always running free when paying out the rope, whilst the other is coupled to the motor which is hauling rope in, and this goes on alternately.

In dealing with pumping the author says: "a disadvantage of these reciprocating pumps is that the discharge is of an intermittent character, and they are liable to damage if for any reason the supply of air in the air vessels fails." Here again, it may be news to Mr. Mercer that there is no disadvantage in the "discharge" being of an intermittent character, and there are hundreds of even large capacity pumps working in mines without any air vessel at all: certainly we have never heard of a case where the breakdown of a pump was due to the want of air in an air vessel. Air vessels are merely fitted to cushion the water-hammer action due to the momentum of the column of moving water.

Finally, Mr. Mercer gives a table showing some financial results of electrical working in collieries, which we think we have seen before; the following is an extract:—

Location.	Old plant.	New plant.	Total cost incurred.	Annual saving.
Scotland	(*a*) Spear rod pump to shaft bottom. (*b*) Two duplex pumps underground with steam pipes, one 800 yd. inbye; attendance, 7 men; fuel consumption, 14 tons per day.	250-H.P. engine driving 130-KW. dynamo; 150-H.P. motor, driving three-throw pump giving 500 gals. per minute, against 600 ft. head; attendance, 3 men; fuel consumption, 2¼ tons per day.	£6,000	Over £3,000

The annual saving is given as £3,000, so that the capital cost of the plant would be covered in two years' working. It would, however, be most interesting to know how this saving is made up. We take it that it is principally due to the lessened consumption of fuel and cost of attendance. Now the saving in fuel is 11¾ tons per day; the saving in wages is four men's wages per day, which may be taken as a fair average at 5s. per day, so that 4 × 5 = £1 per day, and supposing they worked 365 days in the year, we have £365 annual saving in wages. The interest and depreciation may be taken as 10 per cent. upon the capital expended, which comes to £600 per year, and this must be added to the £3,000 to arrive at the gross saving. Now, deducting £365 from £3,600 leaves a balance of £3,235, which is to be saved by the lessened fuel consumption, and taking again 365 days at 11¾ tons per day, we have 4,289 tons per year; dividing this $\frac{3,235 \times 20}{4,289}$ = over 15s. per ton as the price of the coal. It must have been valuable coal! As a journal devoted to electrical engineering, we have every desire to see the use of electricity in mines advanced; but when it comes to figures, let us have actual incontrovertible facts. As to the above, we question them very much, and such statements really do more harm than good.

Electric Tramway v. Motor-'Bus.

At the Automobile Club on Thursday, the 29th ult., Mr. E. Manville, M.I.E.E., read a paper on "The Field of the Electric Tramway and Motor-'Bus." He said that in order that a fair comparison might be made it was essential, in the first place, to realise those conditions which are of primary importance in dealing with the problem of the transportation of large numbers of the public in crowded centres. Two such main considerations were:—(1) Which system would provide the travelling public with the best and cheapest facilities for reaching their destinations; and (2) which system embodying the first requirement was the most profitable to the promoters of the undertaking. It was in the first of these considerations that advocates of the motor-'bus had aroused the controversy between it and the electric tramway.

The author considered the advantages of the motor-omnibus to be: Probable greater speed from point to point; ability to vary the service from one road to another; ability to draw up by the pavement; absence of rails in the roadway; and, where the roads were exceptionally narrow, non-interference with other vehicles desiring to stop by the pavement. Its disadvantages he considered were: High cost of operation, great noise, smell, danger of side-slip, danger of fire, vibration, danger to other vehicles, and unreliability. The advantages of the electric tramway were: Lowest known costs of operation, great comfort, cleanliness and good lighting, comparative absence of noise and vibration, reliability, absence of danger from fire and side-slip and the great improvement of the surface of the roadway. Its disadvantages were: Running on rails, need for passengers to cross to the middle of the road, the need for rails in the roadway being objectionable to other traffic, and in narrow roads, interference with other vehicles.

Referring to the motor-'bus, the author considered that the dangers of side-slip and of fire were of first importance. The first was too well known to need any comment from him, and though up to the present the occurrence of fire had not led to any serious accidents, it obviously might do so. The first of these disadvantages was entirely absent from the electric tramcar, and the second was too remote to merit much consideration, and, after carefully reviewing the above statements, the author thought that the balance of advantages, both to the travelling and non-travelling public, must be conceded to the tramway system rather than to the motor-'bus. If motor-'buses were started in competition with tramways already existing, or if tramways were started, under suitable conditions, in towns where motor-'buses already existed, it was probable that the motor-'bus would cease to exist. Hastings was served with a system of motor-'buses which the author knew were kept in good condition. They paid, he believed, at the rate of 15 per cent. per annum. Until last year there was no opposition from tramways, but about June, the first section of a tramway system was put into operation, the result being that long before the system was completed, the motor-'bus service was entirely discontinued. At Torquay, also, a motor-'bus service had been established, and was now paying well; a tramway service was now being installed there, and it remained to be seen whether history would not repeat itself in this instance. In discussing the financial aspects of the two systems, the author produced the balance-sheet to December 31st last of the Leicester Corporation tramways, which showed that the total cost of operation, including repairs and maintenance, worked out at 4·583d. per car-mile, and that a profit had been made of 0·171d. per car-mile. The author had prepared a balance-sheet showing how the service would have resulted had it been worked by a corresponding number of motor-'buses. The cost in this case would have been 10·510d. per car-mile, and would have caused a loss of 2·668d. per car-mile. From these figures it was evident that such a motor-'bus system, worked under prevailing conditions, could only have been a financial failure. Nevertheless, the author thought there was a unique field open to the motor-'bus in London—first, because tramways could not reach the city, and secondly, because overhead wires not being permitted the capital cost of tramways was abnormal.

In the discussion which followed the reading of the paper,

Mr. E. Shrapnell Smith cited several instances where he stated motor-'buses had been preferred to electric tramways—especially was this so in hilly districts. Side-slips was certainly a disadvantage to the motor-'bus, but he thought it would eventually be overcome, and the danger of fire was not more serious than the danger of being cremated by a live wire. Mr. Smith pointed out the excellent work now being performed by motor-'buses between Peckham and Westminster Bridge. He was authorised to say that Mr. Tilling was so satisfied with the motor-'bus' ability to compete that he had ordered 100 more. Mr. Smith did not think Mr. Manville had been fair in selecting Leicester for comparison, and he thought that it would have been more just to have taken a town of about half the size. In Leicester the traffic was sufficient to maintain a 3½-minutes' service in each direction, which was three times the minimum. Leicester was magnificently equipped, and it had Mr. Manville for its engineer. In many instances tramways were being worked at a loss on account of the capital involved in the track; and there were only about six municipal tramways being worked at a profit. He thought most people would agree that pulling up tram rails was not good policy. Motor-'buses were but in their infancy, and one could not say what the results of development would have on their working costs. He thought that five years ago, for instance, the Leicester figures would have been different.

Mr. E. Garcke confirmed what Mr. Smith had said—he thought that Leicester hardly afforded a fair example for comparison. The cost of 4·583d. was extremely low; of course, the cost could be brought to whatever figure one wished by running a sufficiently quick service. Mr. Garcke pointed out the great advantage motor-'buses possessed in not being compelled to go to the cost of seeking Parliamentary sanction, and in not being hampered in the fixing of their termini as were tramways. For these reasons he was inclined to favour motor-'buses. In a place like Leicester, tramways were almost bound to succeed; but if Mr. Manville had taken a smaller town it was probable that motor-'buses would have shown to advantage. The matter did not depend on the service, however, for there were many other factors to be taken into consideration before deciding which system would be most likely to succeed in a given place. Mr. Garcke agreed with Mr. Manville, however, in his statement that too much had been said in favour of the motor-'bus; the statement, for instance, that motor-'buses were likely to extinguish tramways was not justified by facts. He thought it was a great pity to talk of competition at all, as he considered that motor-'buses should be regarded as feeders to tramways and not as competitors.

Crane Motors and Controllers.

By Claude W. Hill, M.I.E.E.

(*Abstract of Paper read before the* Institution of Electrical Engineers, *February 22nd*, 1906.)

There is at present considerable diversity of practice in determining the size and rating of motors for crane work, the object in all cases being to obtain a size of motor such that in the ordinary working of the crane its temperature rise shall not exceed what is usually considered to be a safe figure, this in English practice being generally 75° F.

In the general run of crane work, we do not know beforehand what the average work of the crane will be, so that the size of the motor has to be a more or less fortunate guess. It is owing to this uncertainty that the diversity of practice has grown up.

Some of the more common methods of specifying are as follows:—

1. The H.P. required to lift or move the load, plus gearing losses, is taken as the B.H.P. of the motor. The motor is specified to be of this power, with a load factor of 20 per cent., 25 per cent. &c. (as the case may be), with continuous runs not exceeding, say, 5 minutes and temperature rise of 75° F.

2. The H.P. required to lift or move the load, exclusive of gearing losses, is taken as the B.H.P. of the motor. The motor is specified to be of this power, and to be capable of exerting double power for a few minutes.

3. The H.P. required to lift or move the load, plus gearing losses, is taken as the B.H.P. of the motor. It is specified to maintain this

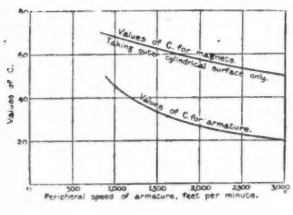

Values of C. for magnets, Taking area of cylindrical surface only.
Values of C. for armature.
Values of C.
Peripheral speed of armature, feet per minute.

Fig. 1.

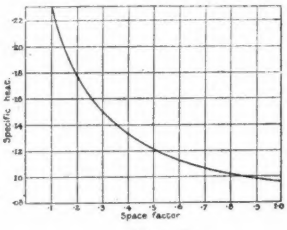


Fig. 2.

power on a continuous run of one hour with a rise of 75° F., and to maintain half this power for four hours with the same rise of temperature.

4. The H.P. required to lift or move the load, plus gearing losses, is taken as the B.H.P. of the motor. It is specified to maintain this power on a continuous run of $\frac{1}{4}$, $\frac{1}{2}$ or 1 hour, as the case may be, with a rise of temperature of 75° F.

In cases where the work of the crane cannot be exactly ascertained beforehand, the author considers that the last method of specifying and testing is most convenient both to the purchaser and to the maker.

The decision as to whether a $\frac{1}{4}$, $\frac{1}{2}$, or 1-hour motor is most suitable in such cases cannot be settled by calculation, but is a matter for judgment based on previous experience.

For the calculations relating to the rise of temperature, the author has availed himself of Goldschmidt's paper, *Journal of Proceedings I.E.E.*, Vol. 34, p. 660, and has used the formula given by Prof. Silvanus P. Thompson in the discussion—

$$c_t = M \times \left(1 - 2{\cdot}718^{-\frac{t}{T}}\right) \quad \ldots \quad \ldots \quad (1)$$

in which M is the final rise of temperature of the motor when running continuously, c_t the rise of temperature at any time t from commencement of run, and T the time in which the rise of temperature M would be attained if there were no loss of heat, in minutes.

The value of M is found by formula No. 2, which was first given by Mr. W. B. Esson in his paper at this Institution in 1888—

$$M = \frac{C\,W}{S} \quad \ldots \quad \ldots \quad \ldots \quad (2)$$

in which C represents the rise of temperature for an energy loss o 1 watt per sq. in. of radiating surface, w the watts, and s the surface in sq. in.

In fig. 1 two curves are given, showing how the value of C, both for the armature and magnets of a bipolar open-type motor, varies with the speed. The temperatures were taken by thermometer, and on 6-hour runs.

In order to determine the value of T in formula No. 1 we require to know the specific heat and volume of that portion of the machine to which the formula is being applied. For an insulated coil we require to know the mean specific heat, which we can derive from the respective specific heats of copper and cotton insulation. The specific heat of such a coil will vary with the space factor, and, taking copper at 0·095 and cotton insulation at 0·38, the curve, fig. 2, has been prepared showing the relation. A further curve, fig. 3, has been prepared from this, showing the relation between the space factor and the watts per cubic inch which would raise the

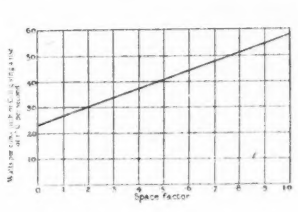


Fig. 3.

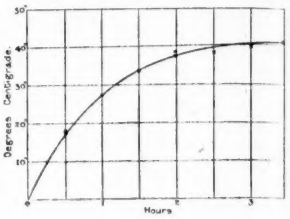


Fig. 4.

Data for Fig. 4:—
Space factor, 0·38. Watts per 1° C. per second, 36·75. Observed points ×.
Watts per cb. in., 0·457. M = 43. T = 58. Calculated points, ⊙.

temperature of the coil at the rate of 1° C. per second if there were no losses.

From the known dimensions of the coil the value of T can be found from formula No. 3—

$$T = \frac{M\,W}{60\,w_1} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (3)$$

in which w_1 are the watts per cubic inch of coil and W the watts per cubic inch (taken from fig. 3), which would cause the temperature of the coil to rise at the rate of 1° C. per second. In the case of open machines a curve based upon the above value of T seems to agree very well with the curve found by experiment, as may be seen in Mr. Goldschmidt's paper, and the curve in fig. 4.

With enclosed motors, in determining T, it appears to be necessary to include something more than the dimensions of the coil, as some portion of the machine carcass in proximity to the coil is heated to practically the same temperature.

As the amount of this additional volume is indeterminate, we may instead multiply T (taken from the known dimensions of the coil) by a constant K found by experiment from the nearest parallel case.

The value of K is given by the formula No. 4—

$$K = \frac{\cdot 434\ t}{T \log \frac{M}{M - c_t}} \quad \ldots \quad \ldots \quad (4)$$

in which t is the time from the commencement of the run at which a temperature is taken, c_t the temperature at that time, and M, as before, the final temperature to which the coil rises.

TABLE I.—Volts in all Cases 220.

Machine.	A.			C.		
Rating	¼-hour	½-hour	1 hour	¼-hour	½-hour	1 hour
Brake horse-power ..	5·62	4·4	3·45	166	122	84
Revs. per minute ..	345	420	490	320	360	440
Efficiency	69·5	76·5	80·5	86·25	89·25	91
Armature:						
Temperature Rise ..	41·5	41·5	41·5	41·5	41·5	41·5
M.	240	130	82	575	295	150
T.	80	80	80	188	188	188
Watts per cubic inch ..	3·5	1·9	1·18	4·1	2·1	1·05
Watts per square inch..	3·8	2·08	1·3	9·2	4·6	2·4
Current density ..	5,500	3,900	2,900	4,950	3,300	2,320
Reactance voltage ..	2·8	2·4	2·1	4·9	4	3·3
Approx. temp. rises with overloads: Temperature rise per minute at rated load	2·76	1·38	0·69	2·76	1·38	0·69
Ditto, current × 2 ..	14·3	6·9	3·2	15	6·4	2·5
" " 3 ..	45·8	17	8·2	50	18·2	6·6
" " 4 ..	147	39	17	172	42	13·4
Magnet:						
Temperature rise ..	—	—	—	45°	42°	35°
M.	—	—	—	320	162	73·5
T.	—	—	—	99	99	99
Watts per cubic inch ..	—	—	—	2·9	1·46	0·66
Watts per square inch..	—	—	—	1·61	0·815	0·36

The Cooling Curve.—An example of a cooling curve, taken off a coil of similar dimensions to that of which the heating curve is given in fig. 4, is given in fig. 5. This curve may be calculated by reversing formula No. 1, but multiplying T by a constant K′, which must be found by experiment.

In Table I the temperature data have been worked out for two sizes of machine—A and C.

For each machine temperature curves have been calculated, and from these, curves such as fig. 6 have been prepared showing the relation between length of run and H.P. for a temperature rise of 41·5° C. (75° F.) on a run of ¼, ½ and 1 hour, the winding being the same for each rating. It will be noted that notwithstanding the heavy loads the reactance voltages, even at the ¼-hour ratings, are not excessive. If, however, the machines were wound for a circuit of double the voltage (*i.e.*, 440 instead of 220), these reactance voltages would also be doubled, and it would then be desirable to use commutating poles.

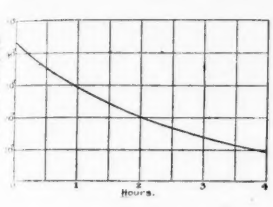


FIG. 5.

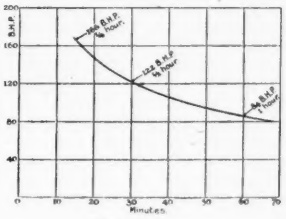


FIG. 6.

The magnet data for machine C show that as T has not the same value for both armature and magnet, their respective rises of temperature, if the windings remain the same, will not be the same at the different ratings.

It has been generally noted among crane-makers that ¼-hour rated motors have a habit of burning out with a facility which has been somewhat surprising to them. Some figures of a rough character given in the lower part of Table I show how very rapidly the rate of increase of temperature increases with the overload on short-rated machines.

From the figures in Table I we may conclude that the ¼-hour motor has a very limited field of application, while the ½-hour motor is suitable for the generality of cranes having low power factors, and the 1-hour motor is suitable for cranes which are worked moderately hard.

In figs. 7 and 8 curves are given showing the relation between

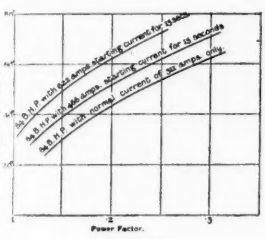


FIG. 7.

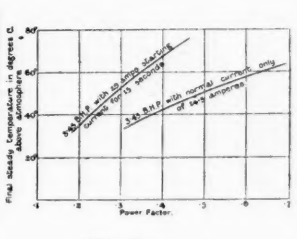


FIG. 8.

Working period one minute in each case.

MACHINE C.—84 B.H.P., 440 r.p.m., 220 volts, 311 amperes.

Rise of temperature in continuous run of 1 hour at 84 B.H.P. = 41·5° C.

MACHINE A.—3·45 B.H.P., 490 r.p.m., 220 volts, 14·5 amperes.

Rise of temperature in continuous run of 1 hour at 3·45 B.H.P. = 41·5° C.

$$\text{Power factor} = \frac{\text{Time of working}}{\text{Time of working + time of stopping}}$$

power factor and final temperature when the machines A and C are run at the same H.P. as would result in a rise of temperature of 41·5° C. in one hour's continuous run.

We note that for the same rise of temperature the power factor of the small machine is greater than that of the large one. This illustrates the point that for a given power factor and rise of temperature, the larger the machine the longer must its time rating be.

A point which has to be taken into consideration is that each time the motor is started its current, for a time, exceeds the normal to a greater or less extent, and we ought, therefore, in our calculations, to take the mean current during the working period, and not merely the current after the motor has settled to its steady speed. If the working period is short, we may for practical purposes take the equivalent current during the period to be as given in formula No. 5—

$$\sqrt{\frac{c_s^2 t_1 + c_n^2 t_2}{t_1 + t_2}} \quad \ldots \quad \ldots \quad \ldots \quad (5)$$

in which c_s is the mean starting current, t_1 the starting period, c_n the normal running current, and t_2 the normal running period. In fig. 7 for machine C three curves are given, one in which no account is taken of the starting current, a second in which the mean starting current is taken at 1·5 times the normal, and a third in which it is taken at twice the normal.

In fig. 8, for machine A a curve is given for normal current only, and a second in which the mean starting current is twice the normal. In all these cases the starting current is taken as being on for 15 seconds out of a working period of one minute.

An examination of these curves shows how very necessary it is to take into account the starting currents when the working periods are short.

In the general run of crane work the power factor is low, as might be expected from the fact that ½-hour motors have been found satisfactory. The lowness of the power factor is due not only to the motors having fairly long standing periods, but also because they do not exert their full power every time.

Where the power varies we have to include the H.P., and the formula then becomes—

$$f = \frac{\text{H P}_1 \times t'}{\text{H P} \times (t' + t'')} \quad \ldots \quad \ldots \quad \ldots \quad (6)$$

in which H P_1 is the H.P. exerted during the time t' and H P is the rated H.P. of the motor.

The power factor so found is correct so far as the supply of current to the motor is concerned. For the purpose of dealing with the motor temperature we require a second power factor given by formula No. 7—

$$f_1 = \frac{\text{H P}_1^2 \times t'}{\text{H P}^2 \times (t' + t'')} \quad \ldots \quad \ldots \quad \ldots \quad (7)$$

We may call the first the external power factor and the second the internal.

In Table II are given some test figures taken from an overhead travelling crane which was designed by the author and constructed by the Cleveland Bridge Co.

On the hoisting gear a shunt motor is used, giving a regenerative effect when lowering, and so reducing the external power factor. On the other hand, the internal power factor is slightly increased by the regenerative current, as the heating of the machine depends

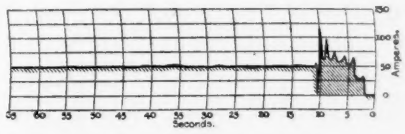


FIG. 9.—LIFTING 15 TONS.

Mean starting current, 53 amperes; mean running current, 50 amperes; mean during run, 50·4 amperes.

only on the passage of a current through it, and not upon its direction. This method of using a shunt motor to drive the hoisting motion of cranes has been in use by the Cleveland Bridge Co. for nearly 2½ years on several cranes, the advantages being complete control over the speed of lowering, a slight economy in current consumption, and a considerable economy in wear and tear of brake gear.

In settling the test to be specified for a crane motor, the internal power factor is an important figure.

Having (either by the test figures of a previous crane or by calculation) constructed a table such as Table II, and found the power factor, and having also determined the horse-power necessary

FIG. 10.—LOWERING 15 TONS.

Mean starting current, 25 amperes; mean running current, 21 amperes; mean during run, 21·5 amperes.

for the crane when fully loaded, we may, by means of curves such ae those of figs. 7 and 8, ascertain the length of run at the full horse-power of the motor, which will give the same rise of temperature as will be attained when the motor is driving the crane in regular work.

Figs. 9 to 12 are examples of amperemeter diagrams taken from the overhead crane, of which figures are given in Table II. These diagrams show the relative starting and running currents, from which the equivalent mean currents during each run have been calculated. They also show the regenerative currents obtained when lowering loads with the shunt motors.

In the design of a controller there are two principal objects to be attained. First, the height of the current peaks must be limited to such an amount as may be convenient, having regard to the circuit-breakers and fuses; and secondly, the motor to which the controller is connected must be brought to full speed within such time as may be required. In order to attain full speed in the shortest possible time the height of current peak on each step of the controller should be the maximum permissible. When the controller is on the first step the current simply depends upon the voltage of the circuit and the resistance of the motor and controller. At this point, then, the resistance in the controller must be such that at the moment the circuit is made the current which flows shall not exceed the maximum allowable. This decides the total amount of resistance, and in order that the current shall rise to the

TABLE II.—30-ton Crane, Handling 15 Tons.

—	Lifting motion.				Traversing motion.				Travelling motion.			
	H.P.	Time (secs.).	H.P. × time.	H.P.² × time.	H.P.	Time (secs.).	H.P. × Time.	H.P.² × time.	H.P.	Time (secs.).	H.P. × time.	H.P.² × time.
1. Lifting	15	64	960	14,400	—	—	—	—	—	—	—	—
2. Traversing	—	18	—	—	3·75	18	67·5	253	—	—	—	—
Travelling	—	52	—	—	—	—	—	—	14·5	52	754	10,933
4. Traverse	—	18	—	—	3·75	18	67·5	253	—	—	—	—
5. Lower	−6	54	−325	1,944	—	—	—	—	—	—	—	—
6. Taking off slings ...	—	30	—	—	—	—	—	—	—	—	—	—
7. Lift hook	9·5	34	325	3,068·5	—	—	—	—	—	—	—	—
8. Travel back	—	49	—	—	—	—	—	—	13	49	637	8,281
9. Lower hook	8·5	34	290	2,456·5	—	—	—	—	—	—	—	—
	—	353	1,250	21,869	—	—	135	506	—	—	1,381	19,314

	External power factor.	Internal power factor.
Lifting motor	$\frac{1,250}{15 \times 353} = ·237$	$\frac{21,869}{15^2 \times 353} = ·275$
Traverse motor	$\frac{135}{4 \times 353} = ·095$	$\frac{506}{4^2 \times 353} = ·089$
Travelling motor	$\frac{1,381}{15 \times 353} = ·261$	$\frac{19,314}{15^2 \times 353} = ·243$

same value each time the controller is moved a step forward, the resistance must be graded in accordance with formula No. 8—

$$R\ a,\ b,\ c,\ \&c. = r \times \left(\frac{C_1}{C_2}\right)^{n-1} \quad \ldots \quad \ldots \quad (8)$$

in which R a is the total resistance with the controller on the first step, R b the resistance on the second step, and so on, r the resistance of the motor, C_1 the maximum current, and C_2 the value to which the current falls before moving on to the next step, and n the number of steps in circuit at any time.

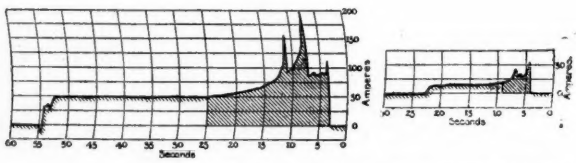


Fig. 11.—Travelling 30 Tons. Mean starting current, 79 amperes. Mean running current, 50 amperes. Mean during run, 67·5 amperes.

Fig. 12.—Traversing 30 Tons. Mean starting current, 28 amperes. Mean running current, 14 amperes. Mean during run, 19 amperes.

From the above formula we can also determine the number of steps which a controller must have in order to fulfil the given requirements, by means of formula No. 9:—

$$n = 1 + \frac{\log R - \log r}{\log\left(\frac{C_1}{C_2}\right)} \quad \ldots \quad \ldots \quad \ldots \quad (9)$$

As an example of the application of the above formula we may compare fig. 9 with fig. 13. The motors and controllers in both cases were identical, but the controller of fig. 13 had the resistances graded in accordance with the formula, while that of fig. 9 had not. It will be noted that in fig. 9 the mean starting current is 53 amperes with a maximum of 140, a ratio of 2·6 to 1, while in fig. 13 the mean starting current is 58·6 amperes with a maximum of 80, the ratio being in this case 1·36 to 1, so enabling the circuit-breaker to be set much closer to the running current of the motor.

In addition to the two principal requirements above mentioned, the controller is sometimes required to be capable of bringing the motor down to a very slow speed. For this purpose additional steps have to be provided, with further resistance in addition to that found by the above formula.

As an example of the application of the formula, a controller design has been worked out for machine C, ½-hour rating, and the complete starting diagram is given in fig. 14. In this it is assumed that the slowest speed required will be 10 per cent. of full speed. and that the lightest load will be equivalent to one-fifth the full torque of the motor, and it is further assumed that a mean starting current of 25 per cent. in excess of the normal running current is required to give the necessary acceleration.

The full lines in fig. 14 show the diagram when starting on full load, and the dotted lines the diagram when starting on the lightest load.

The first three steps are slow-speed steps, and the remaining five are acceleration steps. The motor can, however, be run with the controller on any step without the height of the current peaks exceeding those shown.

Although this controller will reduce the speed to 10 per cent. of full speed on full load and on the lightest load, it will not do so on intermediate loads. To do so using series resistance only would require an altogether impracticable number of steps.

A generally lower speed with any load from the lightest to full load, without increasing the number of steps may be obtained by arranging resistances in parallel with the armature, in addition to those in series on the slow-speed steps.

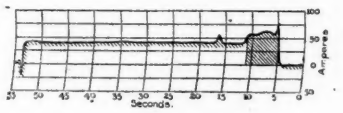


Fig. 13.—Lifting 10 Tons.

Mean starting current, 58·6 amperes; mean running current, 42·5 amperes; mean during run, 43·7 amperes.

By using a resistance of 0·1 ohm in parallel with the armature on the first step, 0·075 ohm on the second step, and 0·065 ohm on the third step, we obtain slow speeds over a wide range of load.

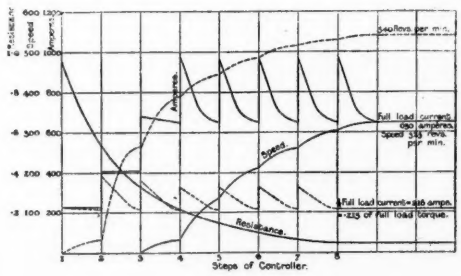


Fig. 14.

Full lines indicate controller diagram with full load.
Dotted lines indicate controller diagram with load requiring one-third full current = approx. one-fifth full torque.

One advantage of using parallel resistances for the slow-speed steps is that the current through the armature when standing exceeds the running current by a greater amount than when series resistances are used, so that the machine can exert a greater starting torque on these steps.

The controller described is only suited for a series motor and positive driving, so that it is necessary to provide in the hoisting train an automatic mechanical brake which will when lowering prevent the load overhauling the motor.

When it can conveniently be arranged, it is better to use a shunt motor and regenerative control for lowering, as already described.

The discussion was opened by Mr. Alexander Siemens, who criticised the methods of specifying for small crane-motors given by the author. He regarded the size of an intermittent motor as depending on the ratio of the time it is actually working to the total time occupied by its series of operations; and secondly, on the length of time it is actually doing work. The load factor alone

is misleading, as it does not indicate the actual time the motor is in use. He thought Mr. Hill's formulæ were not of real practical use, owing to the numerous constants employed, which would have to be determined experimentally, and contrasted these with the methods employed by Mr. Oelschläger, and given in an article which appeared in the *Electrotechnische Zeitschrift* of December 20th, 1900.

Mr. A. H. Bate asked whether the author's overload temperatures were calculated or tested? Personally, he had found from actual tests, much smaller rises of temperature, and did not consider that crane motors were subjected to such heavy overload, as, for instance, tool motors.

Mr. Aitken remarked that crane makers seldom knew what the motors had to do, actually; they were, however, frequently overloaded, owing to unforeseen circumstances. He suggested the probable life of such a motor as seven years.

Mr. Stokes, as a crane maker, criticised the usual crane-motor specification, which he considered contained many little-understood terms. He thought there was another important factor, but rarely taken into account, viz., the "driver factor," which might altogether upset the proportions adopted from scientific considerations. He had in mind an estimate obtained by jotting down all the items which could be remembered, and then doubling the total to make sure: this sort of estimate, he thought, was very applicable to estimates of crane loading.

Mr. Davis commented on the success of shunt motors for crane work; they gave complete control over the motors, the hoisting and lowering speeds being easily regulated; also the rate of acceleration compared well with that of the series motor.

Mr. Hill, in replying, pointed out that the paper dealt with motors running for brief periods only. He agreed that his formulæ would not enable calculations to be made without experimentally determined constants; the constants τ and c had to be found by experiment by almost any method. His formulæ covered the graphical data favoured by Mr. Siemens. The overloads were calculated on the data given in the paper; it was assumed that the heat was confined to the armature winding owing to the intermittent loading. Tool motors certainly had to stand heavy overloads, but a crane motor was an overloaded motor to start with, which was again overloaded in work, and this gave the rapid temperature rise. As to the life of such motors, the Cleveland Bridge Co. had had them working for nine years or so; 220 volts was about the practical limit of pressure which was employed. He concluding by assuring Mr. Stokes that his paper aimed at giving him just the information which he required in a reasonable form.

Mr. Mordey (who occupied the chair in the absence of the President), in proposing a vote of thanks to the author, drew attention to the fact that many alternating-current motors were in use for crane work.

CORRESPONDENCE.

Letters received after first post on Wednesday morning cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

The Naval Engineer and Electricity.

Mr. Rollo Appleyard, after strenuous efforts extending from March 9th to March 27th, has finally brought forth a weird and incorrect attack upon my recent article in this journal. It is difficult to know which of his statements to refute first. Taking them in order, I am compelled to quarrel with his assertion that my knowledge of the facts was incomplete, for I have devoted many hours during the past year in discussing these things with naval engineer officers. Next, his ungenerous, and one might almost say discourteous, interpretations of my remarks concerning Mr. Wordingham's difficult position. I never attacked Mr. Wordingham personally, for in any case it would have been unmanly, and at best unfair. I answered this last week, and express now my regret that it should have been possible to have assumed what I most certainly did not write. I commended his appointment, and I said distinctly that the fault was that the Admiralty had only recently awakened to the need of having an expert on electrical matters. Next I come to the vexed question of the stokers and the engine-room artificers. During the last few weeks the columns of the *Engineering* and the daily Press have contained correspondence upon this subject, every word of which has been forwarded to me by a newspaper cutting agency. My phrase is not "extraordinary," and I prefer to call a man who enters the Navy as a stoker, a stoker, whether he do engine-room watch keeping or is in charge of a stoke-hole. Abler pens than mine have protested against this order, and let Mr. Appleyard read a recent leader in *Engineering*.

In the issue of April 6th of *Engineering*, there is a letter signed by "A Naval Engineer" of life-long experience. I will reply to Mr. Appleyard by quoting him. He answers certain questions as follows:—

Q. Is it a fact that, under the new Admiralty scheme of training, stokers may be promoted to so-called "mechanicians," and placed in charge of a watch at sea?

A. Yes.

Q. Will such appointments displace engine-room artificers who have served a legitimate apprenticeship to an engineering trade, and become skilled artisans?

A. Yes. Obviously, the displacement of skilled artisans by promoted stokers cannot be as efficient an arrangement as the present system; but it appears to be the deliberate object of the new scheme.

Continuing, this correspondent says that:—

As regards the artificers, nothing but friction and trouble can ensue between them and the mechanicians, as each class will feel that it has been placed in an anomalous and difficult position with regard to the other, and this will render the task of the engineer officer of the new creation much more arduous than ever, in spite of the better position he, as an executive, or military, officer, will hold in the disciplinary economy of the ship. The stoker class should be encouraged by the creation of "warrant-officer" rank; but there are many methods of employment for stoker warrant officers other than that proposed in the new scheme.

It will be seen from the preceding answers that, in spite of all that was expected after the promulgation of Lord Selborne's Memorandum of 1902, nothing has practically been done to place the existing engineer branch in the position it should occupy in order to obtain its maximum efficiency. The future changes which that Memorandum indicate, and which are confirmed by the statement of Admiralty policy recently issued, acknowledge to the fullest extent the truth of the contentions of the naval engineer officers, and of the great engineering profession of the country, that the engineer branch should become incorporated with the military branch of the Royal Navy, and that the engineer officers should be given proper military disciplinary control over their men.

There always has been a prejudice against engineers at Whitehall, as this same correspondent points out, for he says:—

All the concessions which have for so many years been shown to be necessary by Admiralty Committees and by the engineering profession tend to the removal of differences and to the establishment of that unity which the Admiralty admit to be so essential an element of strength to the Navy. These differences would have been removed years ago except that jealousy of the increasing importance of the engineering profession, and prejudice against its members, stopped the way. There is, unhappily, reason to suppose that these things are still factors in the prevention of necessary reform, even in this engineering age; and I fear, Sir, that until they are overcome by the pressure of public opinion, they will continue to be a direct and standing menace to the efficiency of the Fleet.

Now, about the instruction at Osborne—for Dartmouth is dragged in by Mr. Appleyard in an unfair manner. I discussed this question with certain officials at Osborne, and I stand by what they told me. And I say that the officers in charge of the submarines had no training in internal combustion engines when at college, and all the syllabuses of engineering ever issued will not make me believe a thing which personal experience taught me did not take place. I yield to none in my admiration for the training which we obtained at Keyham; but excellent as it was, it could have been improved. And so with the training at Osborne.

Now, Sir, one can readily retort with stinging sarcasm to such unjust and ungenerous criticism; but I recognise that Mr. Appleyard by his articles in the *Fortnightly* and in other places has done good work, and earned the gratitude of all thinking people. But our friend tries to paint me as one who, for a bad wicked purpose of my own, wish to mislead a gullible public, and I resent this. I find that it would be better for him to pull out the beam which is in his own eye before troubling about the mote in mine. In an article in the *Times*, of December 20th last, this *Deus ex Machina* uses "an extraordinary phrase," and "misdirects the general public by random statements." He said that until recently engineer officers of the Fleet were drawn from a different class to the executives, and "that the system constituted a vicious circle." Such language is not likely to promote harmony. He went on to say that when the new scheme for common entry was introduced "that first the suggestion was opposed by engineer officers . . . their opposition did not last many days." I venture to say that if a ballot were taken among the engineer officers not one in five would approve of the present system. What they wanted was executive rank, and they recognise that this attempt to produce a jack-of-all-trades will lead to a crisis such as exists at present in the American Navy.

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I have taken up a great deal of your space, and have even now not gone into the subject fully enough. Mr. Appleyard himself makes random statements, and in a pedantic manner accuses me of something which reminds me of the articles-of-war. I say that by his letter he has misrepresented what was contained in my article. There are many, many things in connection with Admiralty policy which are worthy of praise. But when a little thoughtful criticism is made in a friendly spirit, it is un-English to write such a letter as that penned by Mr. Appleyard. I can only hope that he will have the courtesy to withdraw his unjust accusations.

C. Alfred Smith.

London, *April 6th*, 1906.

Neutralised Repulsion Motor.

I notice on page 575, column 2, of your issue of April 6th that Mr. Cramp, in his contribution to the discussion on Mr. Schoepf's Manchester paper, describes what he considers to be an original "neutralised repulsion motor." The motor I refer to is illustrated in fig. 3 on that same page.

I absolutely fail to understand why the motor in question is a "repulsion" motor, and why that particular arrangement should allow of any better commutation than an ordinary series conduction machine. I shall be obliged if Mr. Cramp will kindly explain.

In the meantime I may say that Mr. Cramp's motor appears to me to be simply an ordinary series conduction motor with which a transformer is combined. The more usual way is to have that transformer separate from the motor; the former is, of course, made use of in order to reduce the voltage impressed on the armature. In Mr. Cramp's arrangement the flux produced by the primary

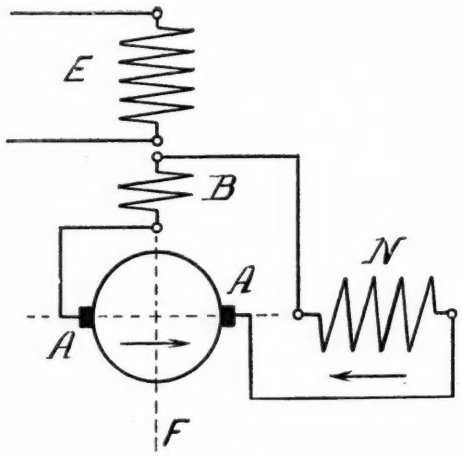

Fig. 1.

coil E has two paths open to it: the one through the armature in a direction F F, perpendicular to the brush line (this part of the flux provides the motor field), and the other through the coil B, where it induces that E.M.F. which is impressed on the armature. It must be at once evident that since the energy is to be conveyed from E to B by induction, these two coils are in the worst possible relative position, and it follows that the weight efficiency of such a machine must be very small indeed.

If I were to design such a motor, I would certainly dispose the coils E and B co-axially as shown in my fig. 1, where A A are the armature brushes, and N is the ordinary neutralising winding in the axis of the field produced by the current flowing through the armature. Personally, I think a separate transformer is more advantageous, but if it be desired to avoid its use, then I distinctly think that the arrangement shown by me (and which I do not claim as my own) is far more efficient than Mr. Cramp's, although both operate in the same way.

I should like to add that I for one, in this country, entirely disagree with Mr. Cramp's classification of alternate-current motors. It is this very unusual classification of his which has evidently led him to believe that the motor he has put forward is a "repulsion" motor.

These single-phase commutator motors are now fast coming into general use, and it would be to the interest of all concerned to agree to and abide by one uniform classification.

Val. A. Fynn.

London, *April 7th*, 1906.

Motor-Cars.

My attention was drawn to a paper on "Electric Ignition for Motor-Cars," read by Mr. Frank Little before the Newcastle Local Section of the Institution of Electrical Engineers on February 5th, 1906. In the course of this paper I found a number of paragraphs which seemed to me to have a singularly familiar sound. I have extracted some of these paragraphs, and have placed them side by side with some paragraphs from a book entitled "O'Gorman's Motor Pocket-Book," of which I happen to have a copy. Before sending you these parallel extracts, I wrote to the secretary of the Newcastle Local Section, and asked him whether any acknowledgment of the origin of these paragraphs had been made, and he very promptly sent me a copy of the original paper, in which I looked in vain for such acknowledgment.

Mervyn O'Gorman.

London, S.W., *April 7th*, 1906.

[The paragraphs are practically identical.—Eds. E.R.]

Dr. Kuzel's New Lamp.

We shall be very much obliged if you will kindly allow us, through the medium of your paper, to draw the attention of those interested in electric incandescent lamp manufacture to some incorrect reports regarding a "Wolfram Lamp" which have lately been appearing in the trade journals.

The name of the inventor of this Wolfram lamp is stated to be Herr Koszel, and we take this opportunity of making public the fact that the lamp in question has nothing whatever to do with the new process invented by Dr. Hans Kuzel, of Baden, Vienna, whose sole representatives we are.

These reports originally appeared in certain Vienna papers, and were published on behalf of sundry financial people for ulterior motives. The lamp in question we refer to, and which has been the subject of these reports, has been worked on to our knowledge for the last five or six years without success, but no results of tests, official or otherwise, have been published; whereas, full information has been given with regard to Dr. Kuzel's invention, the negotiations for the commercial exploitation of which are not yet completed.

pp. **Fahn & McJunkin,**
R. R. Cook.

London, W., *April 5th*, 1906.

WASTE IN INCANDESCENT ELECTRIC LIGHTING.

[communicated.]

The paper read by Mr. Geo. Wilkinson, Borough Electrical Engineer of Harrogate, before the Leeds Local Section of the Institution of Electrical Engineers, on February 15th, was reprinted in abstract in our issue of March 16th. Our readers will thus have been able to acquaint themselves with Mr. Wilkinson's methods at Harrogate for reducing his consumers' electric light bills, by endeavouring to secure for them lamps of guaranteed candle-power and efficiency only. As the whole question of lamp efficiency and grading is now under consideration by the Engineering Standards Committee, we do not propose to criticise Mr. Wilkinson's paper,

and thereby do anything to discourage his work, or to hamper the proper consideration of the subject by the Committee. There are, of course, many things that might be said on the question from the points of view of the manufacturers, the contractors and the consumers; but whenever an attempt is made to control anything, someone's liberty of action is bound to be affected. Universal liberty of action is an impossible state of things, and the only thing to aim at is that which benefits the community as a whole, even if it be at the expense of the few. Therefore, we think that Mr. Wilkinson's action at Harrogate can be accepted without prejudice, and it is to be hoped that the ball which he has set rolling will lead up to "the larger policy," of which Mr. Wilkinson's efforts may be called an instalment.

There is, however, one criticism that we can make, without in any way depreciating what Mr. Wilkinson did say, and that is to draw attention to what he did not say. Of course, he set out to limit his remarks to lamp efficiency and graded candle-powers; but this is only touching the fringe of the whole subject of waste in incandescent electric lighting. To be more explicit: The consumer may be supplied with the most perfect lamps, but these will not enable him to run his installation economically, or cause his bills to compare favourably with those of his neighbour who uses gas; and as we think it is agreed that every station engineer's aim and duty is to compete with gas, and to do so successfully if any further large increase in electricity supply is to be expected, it is at once evident that there is much more to be done besides guaranteeing efficient lamps. The consumer has to be educated if electric lighting is to make any further appreciable inroads on gas, and the question therefore arises, Who is more suited for this duty than the station engineer? The contractor and the manufacturer might be suggested; but they have their own axes to grind. So has the station engineer, but then his axe is also the consumer's axe. The gas companies have found that it pays them to educate their consumers; it stands to reason, therefore, that the electricity supply authorities would also benefit, and if station engineers are at present not properly supplied with assistance in this respect, the sooner each one has a publicity department the better for their undertaking, the industry, and the whole community. Of course, the education of the consumer will involve the control of other things besides lamp efficiency. (It will be noted that we do not advocate any system of supply of materials, so detrimental to competition and to the retail trade). For instance, it might necessitate a certain amount of interference with those who at present "advise" on lighting jobs. But if this action tends towards the cheapening of the consumer's bills as against the swelling of profits or commission on lighting jobs, then what matter? For if electric lighting be thus made more popular, there will be larger retail turnovers and more commissions, to say nothing of increased station outputs. As to the methods to be adopted in order to obtain this control, it is for others to work these out. We merely suggest here what is required of the station engineer in order to increase his load by educating the consumer.

First and foremost, before any education is attempted, it is necessary to obtain the consumer's confidence and goodwill. A child cannot be taught if his master has not obtained his confidence; and in matters electrical the average consumer is a child. The chief obstacle that stands in the way of the consumer's confidence is the method of charging which is generally in vogue. The layman cannot understand it, and what he does not understand he looks upon with suspicion. We have no intention at this point of raising a controversy on the maximum demand system; but it has been amply proved that a supply undertaking can get along quite well without it, and however useful it may have been in the past, we do not consider it well adapted to the conditions which now obtain.

The flat rate is the proper method of charging with an ideal load factor, and it is only logical to assume that there will be a nearer approach to the latter by using a system of charging under which the consumer knows where he is, than by discouraging him and raising his ire by enforcing a system involving some little inconvenience, and based on abstruse considerations, however correct these may be in theory. A man's domestic habits cannot be changed by fines; and he resents having to pay more for his light because he has always been used to dining at a certain hour and does not find it convenient to change it. This is how it appears to the consumer, at any rate, and there are many signs which show that supply authorities are beginning to see that the system has its disadvantages.

Having, then, obtained the confidence of the consumer by charging him on a system that he can understand, it becomes an easier matter to advise him on matters of economy. We will assume, therefore, that the would-be customer, being aware that he will be charged for just as much electrical energy as he uses, and not for when he might use it, is willing to become a consumer. Under the ideal condition of things that we are imagining, it must be necessary for him to give notice to the supply authority of his intention, and not to have his house wired all wrongly first. In the case of builders, the same procedure should be compulsory. But at this point compulsory methods must cease, and the gentler arts of persuasion and advice take its place. A horse can be led to the water, but you cannot make it drink or decide in what manner it should do so. The liberty of the individual must not be restricted so long as he conforms to moral and social laws, and for this reason we are quite out of sympathy with the suggestion that Clause 18 of the Electric Lighting Act, 1882, should be abolished. Why should a man be compelled to purchase a certain kind of lamp if he prefers another, *so long as he has been properly warned as to the results?* If he then knowingly incurs the risk of paying more for his electric light, the fault is his. What should be made compulsory is the act of warning. Therefore, on receipt of notice from a would-be consumer or a builder that he intends to wire his house, the supply authority should send him a clearly written pamphlet of advice, with an offer to follow this up by a personal call, *if this is wished for*. This cannot be forced, but we believe that in 99 cases out of 100 it would be taken advantage of. We are met by a slight difficulty if a consulting engineer has been retained. But it is hardly possible that any consulting engineer of repute would advise in a contrary sense to the supply authority on general principles; if he did, the consumer should be able to judge for himself as to which side was right, by a consideration as to who would derive the greater benefit by his adopting this or that advice. Having arrived at the principle that advice should be tendered before a house is wired, if then the owner or tenant deliberately ignored it, the supply authorities could wash their hands of him and, feeling that they had done their duty, rest content in the assurance that they had obtained a good customer. Of course, the advice offered must vary to some extent with the conditions of lighting and the nature of the building—public-house, shop, villa or mansion.

The following are suggestions merely thrown out as a guide; the details would have to be filled in according to the merits of each case, the varying views of central station engineers and the progress of information on the wiring and illuminating questions.

First, as to the control of the circuits. In many houses it is the custom to have a main switch at the meter, and nothing between this and the point switches in the rooms. As a result, it is open for servants to have lights burning in situations where they are not required at all. Each floor should have a separate control switch, and all such switches should be assembled at some place of easy access, and in a position where there is most traffic—generally on the living room floor. By this means it could be ensured that all bedroom lights were out when the bedrooms were not in use; all kitchen or basement lights when the servants had gone to bed; and all lights in servants' bedrooms half an hour after 10 p.m., or whatever hour of retirement is in force. In small houses such precautions may not be necessary; it all depends on the habits of the consumer, and this is where the question of personal advice comes in. Similarly, the control of the sub-circuits is most important; and the more point switches at the door the better, so that it could be made impossible for more lamps to be burning in a room than are required at one time. Wall plugs should each have a separate switch, either at the door or by the plug, depending on the nature of the room. For instance, in the living rooms where

wall plugs are used for general lighting (for candelabra, &c.), the switches should be at the door; where used for special or occasional lighting (as for table standards), the switch may be on the same base as the wall plug. But everything should be done to secure using the minimum number of lamps possible—that is, to prevent more lamps being used than are really required. The house that has its wiring well controlled has a chance of being illuminated economically, especially if the further points to be dealt with are taken into consideration.

We next come to the subject of fittings, a most important question, and one very difficult to advise on. Fittings makers turn out many beautiful "creations" to capture the artistic eye of the consumer's wife, but a large proportion of these are the cause of much of the grumbling that station engineers have to put up with. It is only with the co-operation of the manufacturers that the supply authorities would be able to achieve complete success on this point. Fittings that are made to hide the lamp with all sorts of fringes, silks and other fandangoes are not practical, however artistic they may be. Of course we do not refer to cases where a lamp is hidden horizontally and its light reflected vertically, but to those fittings where encouragement is given to the obscuring of the light generally.

This brings us to the question of illumination as a whole, a subject that is only "in its infancy." An American station engineer, in a recent discussion on this subject, expressed the wish that something could be done "to prevent the artistic women putting fool crinkled paper round their lamps and then coming to kick at the charges." There is more waste in electric lighting through faulty illumination than through the use of bad lamps or any of the other reasons already given. In such a condition of things as we are imagining the supply authority would have an illuminating expert on their staff, who would advise intending consumers, or those who "kicked at the charges," as to the most economical method of lighting their rooms, with due reference to the hangings and other factors of each case. Into the question of illumination enters the personal element to a large extent; the consumer has been used to see plenty of little dots of light about, nicely shaded or tucked away on the ceiling. He must be educated up from this to more useful things. The lights must be at such a height as to get the best value out of them; they must not illuminate the walls at the expense of the floor; the fittings must be simple; the units of light should be large and few; and above all, reflected light must be used to its utmost capacity. The value of reflecting and dispersing shades is hardly appreciated. For reflecting, an 8-c.p. lamp under a holophane shade is sufficient for lighting an ordinary small living room; three will light a good sized room so that one may read anywhere. For dispersing, a holophane globe, or one of the large-bulb lamps with opal shade, is quite sufficient for a small living room. Instances of the sort could be multiplied, but no hard-and-fast rules can be laid down, although it may be said that a lamp under a holophane shade, properly chosen, will throw downwards at least five times its rated candle-power.

The question of lamps has been amply dealt with by Mr. Wilkinson. The consumer may be advised on this point, but as we have shown, he can make a fool of his electric lighting bill with the best branded and guaranteed lamps, unless he goes further. For places where there is little traffic, such as passages and staircases, the consumer should be encouraged to use lamps of low candle-power, but not less than 5 c.p., and not blackened lamps. On the other hand, in lavatories and bath rooms, where only intermittent lighting is required, old lamps can very well be employed. This is a use for such lamps that may be advocated instead of throwing them away.

Such are a few suggestions thrown out to show how Mr. Wilkinson's methods may be extended. We have not mentioned high-efficiency lamps, because, *ceteris paribus*, their use would obviously tend towards economy. Our object has been to show that with the ordinary materials at present at hand, but arranged in different "aggregates," electric lighting can be made so much more economical that we cannot doubt it would compete successfully with gas. But to secure the new arrangement there must be a directive force—to wit, the central station engineer.

BUSINESS NOTES.

The New Spanish Tariff.—The new import duties proposed by the Spanish Government are of a highly protectionist character, and are intended to serve for the development of native industries. The following are some of the imposts which are in contemplation:—

Dynamos, motors and transformers and parts of same up to 8 cwt.	50 pesetas	per 50 kilog. or cwt.
Do. Do. above 8 cwt.	25	,, ,,
Accumulators	12½	,, ,,
Cables (not lead-covered) over 1 centimetre in diameter	25	,, ,,
Other cables and wires of less than 3 mm. ..	60	,, ,,
Telegraph apparatus and telephones	3	,, per kilog.
Arc lamps	2½	,, ,,
Arc lamp carbons	1	,, ,,
Incandescent lamps	10 to 15	,, ,,
Measuring instruments	50	,, ,,

The increase in the case of dynamos and motors amounts to 500 per cent., the present rate being 5 pesetas per hundredweight, and the duties are, moreover, payable in gold instead of on a silver basis as at present. On the other hand, the duties on raw materials, as, for instance, iron and steel, are proposed to be reduced to assist in the promotion of home branches of the engineering and electrical trades.

Motor-Car Accessories.—Messrs. Ward & Goldstone, of Strangeways, Manchester, have issued a supplementary list of electric motor-car accessories. Two of these devices we illustrate. In fig. 1 is shown the "Indispenso" accumulator charging adapter and polarity indicator. With this device motorists are enabled to charge their accumulators at home or on tour, from any continuous current supply. The adapter A is placed

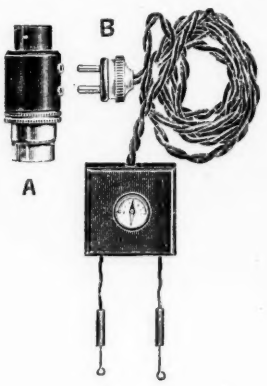

Fig. 1.

Fig. 2.

in the lampholder of any bracket or pendant, and the lamp is placed in the holder attached to the adapter. The plug B is then inserted in socket holes of the adapter. To find the polarity the two connecting hooks are to be placed together, when the blued point of the needle in the indicator will point to the positive wire; the wires are then broken apart, and the positive wire connected to the + terminal of the accumulator, the remaining wire to the − terminal, when charging will commence. Fig. 2 shows a tail lamp complete with lampholder and flexible connecting cord. Other details in the list are batteries, test lamps, measuring instruments and sparking plugs. Messrs. Ward & Goldstone are making motor-car flexibles for both low and high tension.

A New Trolley Wheel.—One of the disadvantages attending the overhead trolley system is the need for frequent renewal of the trolley wheel. To reduce this difficulty, the British Johns-Manville Co., Ltd., has recently placed upon the market a wheel which is made of copper purified to a high degree and toughened by a special secret process. We are informed that these wheels have been subjected to the test of service, and have shown exceptionally long life, averaging about 15,000 miles. The wheels wear smooth and even, and do not pit, arc or burn. The wheels are made of the best grade of pure lake copper only, which is treated chemically to reduce to a minimum any foreign substances which it may contain. By a further process the action of the atmosphere is excluded, and the copper subjected to the action of carbon in order to remove the oxygen and render the metal solid when cast, in this way increasing its malleability and durability. A third process toughens the metal without hardening it, and the wear is reduced to a minimum, the conductivity of the wheel being equal to that of the wire. The wheels are furnished with bushings packed with a specially prepared anti-frictional packing which is also a lubricant.

The Tantalum Lamp.—The price of the tantalum lamp has been reduced by the Siemens & Halske Co. from 4s. to 2s. 6d. each, as a result of the introduction of improved methods of construction and a considerable increase in the production, which have lowered the cost of manufacture. As an illustration of the economy realised by the use of the lamp, it is stated that on the basis of the present price of 4·8d. per kilowatt-hour in Berlin, a lamp of 25 c.p. burning 1,000 hours in a year will consume less

energy to the extent of 11s. 6d., as compared with a carbon filament lamp of the same candle-power. The saving in current in the case of a 16-c.p. tantalum lamp is said to be 3s. 6d. in twelve months.

Catalogues and Lists.—Abner Doble Co., San Francisco, U.S.A.—Bulletin No. 7, 1906, which contains 100 pages of excellently illustrated descriptive matter relating to Doble tangential water wheels. The constructive features of the high-class wheels turned out by the company, which range up to 9,000 or 10,000 h.p. each in size, and which have met with great appreciation in hydro-electric power plants in the States, are concisely dealt with. Some 35 pages of valuable hydraulic tabulated data are included, together with a summary of information required for estimating for this class of plant. The company are specialists in their own line, and their pamphlet is of particular value to those interested in the development of water power.

Messrs. Evershed & Vignoles, Ltd., Chiswick.—New list (No. 2, abridged, March, 1906) giving description and prices of the "Megger" insulation testing instruments.

A.E.G. Foreign Department, London, W.C.—We have received from this company a copy of the *Industrial Messenger* for January, a German paper, which contains only one article, and that a very full and detailed one, giving an account of modern equipments of wireless telegraph stations on the "Telefunken" system. The matter is in English, and is accompanied by many large half-tone illustrations of the different parts of the equipments named. We have also received a copy of pamphlet No. 5 (44 pp.) giving very full information, with diagrams, and much tabulated data respecting series and three-phase motors for intermittent service.

Sterling Telephone and Electric Co., London, E.C.—Pamplet No. 122 (48-pp.), fully illustrating the various patterns of "Sterling" telephone instruments, including Twencen, Hygienea, battery call, magneto call, intercommunication, central battery and other sets. Switchboard mining and other bells, and various accessories, are listed and priced.

British Aluminium Co., Ltd., Westminster.—New price lists have been issued of light aluminium alloys and pure aluminium.

Book Notices.—The *National Telephone Journal*.—We have received a copy of the first number of this publication—upon the appearance and contents of which the editing committee is to be congratulated. It is a threepenny monthly journal, published for the benefit of the staff of 16,000 workers, or as its sub-title indicates, it is conducted "By the Staff for the Staff." Among other interesting matters appearing in this first number is "The General Manager's Message." There is a paper on "Office Organisation," read before the Glasgow Telephone Society by Messrs. Anderson and Thyne; an article by Mr. C. E. Fenton on "New Instruments for Old"; a reprint of Mr. J. J. Carty's recent American paper on "Telephone Engineering"; interesting matter relating to municipal telephone competition; and a page or two of personal notes and news relating to staff gatherings.

"Uber das Spektrum des Elektrischen Hochspannungslichtbogens in 'Luft." By B. Walter. Reprinted from *Annalen der Physik*, Fourth Series, Vol. 19, 1906. Leipzig: J. A. Barth.

"Transactions of the N.E. Coast Institution of Engineers and Shipbuilders." Vol. XXII, Parts 3 and 4, 1905-6 (March, 1906). Newcastle-on-Tyne: The Institution.

"Proceedings of the American Society of Civil Engineers." Vol. XXXII, No. 3, March, 1906. New York: The Society.

"Bulletin of the Bureau of Standards." U.S. Department of Commerce and Labour. Vol. I, No. 3. Washington: The Department.

"Technical Dictionary in Six Languages"—English, French, German, Italian, Spanish and Russian." By K. Deinhardt and A. Schlomann. Vol. I.—The Machine Elements and Tools for Working in Metal and Wood. London: A. Constable & Co. Ltd. 5s. net.

"Journal of the Junior Institution of Engineers." Vol. XVI., Part 4, April, 1906. London: Percival Marshall & Co. 1s.

Trade Announcements.—Messrs. Ellwood and Sledmere (late with J. S. Henry, Ltd.) are showing at 53, Mortimer Street, Cavendish Square, W., their artistic wooden electric fittings. The trade are invited to view. Catalogues, &c., will be sent on application.

The Electric and Ordnance Accessories Co., Ltd., have moved to larger and more convenient premises at 27, Upper Priory, Birmingham, where they have a well-appointed showroom, in which they are exhibiting motors, controllers, &c., of their manufacture. They have also been appointed agents for the following firms:—The Walsall Hardware Co., Ltd., for conduits and fittings, &c.; the Premier Accumulator Co., Northampton, for stationery cells; the Electric Ignition Co., for portable batteries, coils and motor-car ignition apparatus. Stocks of these firms' manufactures, and also their own, are held at the new address.

The Bryan Donkin Co., Ltd., of Chesterfield, have acquired the business and works of Bryan Donkin & Clench, Ltd., Chesterfield, as from the 23rd ult. A new company has been formed under the title of the Bryan Donkin Co., Ltd., with, we understand, ample capital for carrying on and extending the business, which will continue under the same management as hitherto. Mr. H. J. Donkin will act as London director, and Messrs. George Clark and Alfred George Webb as local directors at Chesterfield.

Royce, Ltd.—In future all communications, of whatever nature, should be addressed "Royce, Ltd., Trafford Park, near Manchester," the commercial manager's office having now been removed there.

Ernest Scott & Mountain, Ltd.—The company wishes to remind some of its correspondents who have forgotten the fact that all letters should be addressed to Close Works, Gateshead-upon-Tyne.

The office of the secretary (Mr. H. G. Graves) under the Inventions and Designs Act, which is now a branch of the Department of Commerce and Industry, Government of India, has been removed from Treasury Buildings (Imperial Secretariat Buildings), Government Place, West, Calcutta, to No. 2, Bankshall Street, Calcutta. All communications should in future be addressed to the Patents Secretary, 2, Bankshall Street, Calcutta.

Messrs. Mather & Platt, Ltd., have removed their Glasgow office to the Edinburgh Life Assurance Co.'s Building, 124, St. Vincent Street.

Patent Law in Roumania.—Messrs. W. P. Thompson and Co., patent agents, Liverpool, writes:—

The Roumanian Government has just passed a patent law. Patents are granted without examination, and without any guarantee of novelty, utility or legality. All inventions patentable in this country can be protected in Roumania, except foods for men or cattle, medicines, healing or disinfecting devices, but inventions connected with war or Government monopolies can be appropriated by the Government on such terms as the Court may consider just. Patents last for 15 years except when imported from abroad, and patents of addition for 10 years. Up to July 13th, patents can be granted for inventions already patented abroad to expire with their home patent, but after July 13th nothing can be patented that has been patented more than six months abroad, or has been published in any country sufficiently to enable the working to be properly performed from such description. The costs of patents are two or three times those of this country.

Motor Vehicles for Central America.—The British Empire Motor Trades Alliance, Ltd., has received an inquiry from a firm about to establish an automobile agency in a large town in Central America, desiring information regarding British motor vehicles and accessories, including catalogues, technical descriptions, prices, discounts, weights, measurements, freight rates, and special foreign discounts to agents, &c. As the roads and streets are very bad, the motor vehicles must be very strong and not extra heavy; wheels must be high, at least 36 in. or 40 in., with solid rubber tires, pneumatics not being practical there. If the motive power is gasoline, the ignition must be by a magneto or storage batteries; dry batteries will not give satisfaction. British manufacturers are requested to communicate with Mr. J. B. King, secretary, 11, Red Lion Square, London, W.C.

Liquidation.—Electrical Bleaching Co., Ltd.—A meeting will be held at Nottingham on May 7th, to hear an account of the winding up.

Bankruptcy Proceedings.—Edward Mann.—An application for an order of discharge was made last week to Mr. Registrar Brougham at the London Bankruptcy Court on behalf of Edward Mann, electrical engineer, Palace Chambers, Bridge Street, Westminster. The Official Receiver reported that the bankrupt failed in November, 1904, with provable debts £9,794, and no assets of realisable value. From June, 1898, to May, 1899, he carried on business as above, and at the latter date he formed the Compass Trading Co. to take it over. The company had a nominal capital of £5,000, and as vendor the bankrupt received £1,000 in cash and shares. He was appointed managing director at a salary of £500 per annum, but the full amount was paid only during the first year, and in July, 1904, the debenture holders took possession. The bankrupt attributed his failure to his liability under guarantees given by him for the Compass Trading Co., and to his own ill-health. He had admitted that he had no means of discharging his guarantees if the company failed to pay their debts, but he alleged that if it had not been for his absence through illness the debenture holders would not have taken possession of the business, and further, that he gave the guarantees upon the undertaking of the directors that all the debts of the company should be paid. On the ground of insufficiency of assets to pay 10s. in the £ to the creditors, the order of discharge was suspended for two years.

James Wood Smith, electrical engineer and contractor, Darwen.—A first and final dividend of 9⅔d. in the £ is payable on April 11th (Official Receiver, 14, Chapel Street, Preston.)

Reyrolle Motor Starters.—Reyrolle starters are being made by Messrs. A. Reyrolle & Co., Ltd., at their works at Hebburn-on-Tyne, and they are not being manufactured by anybody else. We are asked to state this fact because a rumour is current to the effect that the firm are having a certain number of their motor starters made by outside firms. While it is true that the company are experiencing a very large and rapidly increasing demand for these starters, and are very busy in consequence, and have considerable extensions to the works in progress, there is no truth in the rumour mentioned, as the starters are being entirely made at the Hebburn works.

Canada.—The *Birmingham Daily Post* states that the municipal authorities in Ontario are urging the Provincial Government to take up the supply of electrical energy generated from Niagara Falls sell in bulk.

South America.—A scheme is on foot to establish another E.L. Co. in Pergamino, as the existing concern is said to be unsatisfactory. It is stated that $100,000 have already been subscribed for the purpose.

A large hydro-electric installation is now being started in connection with the Yaraguasu Waterfalls at Bahia (Brazil) for upwards of 100,000 h.p. From this installation it is believed that the whole of the railways of Lower Peru can be dealt with. The Lake Titicaca, from which the fall is supplied, is the highest lake in the world, situated at an altitude of 3,800 metres above sea level.

LIGHTING and POWER NOTES.

Boston.—The T.C. recently passed a resolution consenting to the application of the National Provincial Electricity Corporation for a prov. order to supply electricity within the borough.

Caerphilly.—The B. of T. has sanctioned the E.L. scheme submitted by the U.D.C.

Cannock.—The U.D.C. has approved and sealed the agreement with the Shropshire, Staffordshire and Worcestershire Electric Power Co. for the sale of the Council's provisional order. The company undertakes subject to the sanction of the Board of Trade to light a compulsory area in Cannock within 12 months, and portions of Hednesford and Bridgtown within 20 months. The company also agrees to pay a sum equal to the costs incurred by the Council in obtaining the order.

Continental Notes.—GERMANY.—The first installation of electrical plant for public supply in Berlin dates from 1885, and was of about 150 KW. In 20 years this has grown to 40,000 KW. The following table is interesting as showing the number of millions of units supplied for different purposes during the last 11 years, the total supplied last year being 111,567,000:—

Year.	Light.	Motive power.	Trams.	Total.
1894-1895	6·344	1·122	—	7·466
1895-1896	7·580	2·269	0·257	9·906
1896-1897	8·681	4·030	1·758	14·469
1807-1898	9·944	5·847	2·443	18·234
1898-1899	10·905	7·792	10·167	28·864
1899-1900	12·502	17·343	30·169	50·014
1900-1901	13·796	22·378	34·111	70·285
1901-1902	15·082	23·317	41·232	79·628
1902-1903	19·289	25·054	41·425	85·768
1903-1904	22·642	30·643	45·466	98·501
1904-1905	27·060	37·219	47·288	111·567

It will be noticed that since 1900 the amount of energy supplied for power purposes, which includes the supply for over 2,000 heating appliances, has been greater than that supplied for electric lighting. The total amount of apparatus installed on the premises of the 14,700 consumers is over 100,000 KW., the number of motors being about 15,400, with an aggregate rating of about 41,000 KW. At the end of last year the number of lamps being supplied was 619,625 incandescent and 26,612 arcs; of the latter 651 are used for public lighting. The total length of network attached to the generating station is 3,736 km.

The Krupp Steel Works are constructing electrical furnaces for the preparation of steel.

HAMBURG.—In 1896 there were two generating stations for supplying the city; another of 5,600 KW. was added shortly afterwards; in 1898 this was increased by 3,500 KW. to supply the northern part of the town; in 1901 a plant with a capacity of 1,200 KW. was added to provide three-phase energy at 5,000 volts, which is reduced at sub-stations to 220-volt D.C. Recently three more units, each of 2,500 H.P., have been installed to supply continuous current at 600 volts for the tramways; two three-phase turbo-alternators are on order, each of 1,750 KW. When these are added the total capacity will be 30,000 KW.

ITALY.—The Novi Sigure T.C. is negotiating for the construction of municipal electricity works with a plant of 200 H.P., and a battery of accumulators. About 500 public lamps are required for lighting the streets.

WATER POWER IN SWITZERLAND.—H.M. Minister in Switzerland (Sir G. F. Bonham, Bart.) reports that the National Council has passed a resolution by a large majority, which will not only prevent the neighbouring States from deriving advantage from Swiss water power, but will doubtless lead to Switzerland developing the enormous resources of power stored up in its mountain streams and rivers, and rendering itself practically independent of fuel supplied from abroad. By the terms of the resolution, the diversion of electric power derived from hydraulic pressure, is made subject to the authorisation of the Federal Council under reservation of rights already granted by existing International Treaties.

The Federal Council grants permissions if the power is not employed in Switzerland, and if no Swiss interest is injuriously affected; permissions cannot, however, be granted for a period exceeding 20 years, but they are renewable.

A term of three years is fixed for the duration of this decree, subject, however, to renewal by the Federal Chambers, and it is to be enforced immediately on account of its urgent character.

Sir G. Bonham says that it will, however, be necessary to provide an additional article for the Constitution, confirming the action embodied in the resolution, and presumably further defining the policy which will be pursued with regard to this question.—*Board of Trade Journal.*

PARIS LIGHTING SITUATION.—As a result of the advertised wish of the Municipality to receive proposals for the carrying on of the lighting of the City of Paris on the expiration, in a year or so, of the several concessions now worked by the "Secteurs," the examination by the Prefect has given results which may be considered as negative. The public appeal, decided upon on December 27th last, has not caused the submission to the city of any projects offering advantages superior to those contained in projects already in the hands of the Commission. One of these was submitted by a syndicate formed last autumn in Paris, with the object of consolidating the Paris lighting interests, and obtaining a concession from the city for the future exploitation of electric lighting in the city. It is this project that the Prefect of the Seine advises should be accepted. It is known as the Schneider-Mildé proposal, these two firms having controlling interests in the syndicate. In this scheme the problem of the "transition period" is solved by merging it in the new concession which is sought by the syndicate. It is considered that in the proposals of the syndicate, the interests of the city and those of the consumer are safeguarded. The Sub-Commission of the Municipal Council is still willing to take into consideration any proposals which may be made for the future *régime* of the lighting of the city, and the deliberations of this Commission will form the subject of a report which may contain conclusions differing from those now presented by the Prefect of the Seine.

Dublin.—The L.G.B. has sanctioned the borrowing by the Corporation of £28,000 for the extension of the electric lighting system to Clontarf.

Dudley.—Mr. H. Ross Hooper, on behalf of the L.G.B., on Friday in last week, continued and concluded the inquiry relative to the application of the Corporation for sanction to borrow £22,000 in connection with the electrical undertaking, £9,322 being required for new works, £2,000 for extra cables, and the balance to cover excesses of expenditure in respect of previous loans. Complaint was made by Mr. Hooper that he had been there three times and on each occasion had received different figures as to the amount of the excess of expenditure on the second loan. The inspector promised to report.

Edinburgh.—The E.L. Committee has agreed to recommend that the annual charge for public arc lighting should be reduced from £10 15s. to £9; for private consumption from 3½d. to 3d. per unit; and for power from 1¼d. to 1⅛d. per unit; and it was further resolved that to special power consumers the charge should be from 1 1/10d. to 1d.

Heanor.—The U.D.C. has under consideration an E.L. scheme submitted by the Notts. and Derbyshire Electric Power Co.

India.—KASHMIR.—From the *Times* we learn that a company has been formed, with a capital of £2,000,000, to construct a hydro-electric power installation in Kashmir, by harnessing the Jehlam river. The prospectus states that energy is to be supplied to operate an electric railway 200 miles in length to connect Abbotabad with Srinagar: to operate a fleet of powerful dredgers, which will be employed in safeguarding Kashmir against floods and in reclaiming rice-producing tracts of land from the marshes, also to supply the motive power for numerous proposed factories, &c., and a supply power for local tramways and light railways, arsenals, workshops, foundries and mines. It will also provide energy for electric lighting and punkah driving in the military cantonments of Northern India. The initial supply will be equivalent to 80,000 H.P.

Lincoln.—A L.G.B. inquiry was held on April 4th, into the Corporation's application for a loan of £13,000 for electricity purposes.

Llanelly.—A L.G.B. inquiry was held last week in regard to an application by the U.D.C. for permission to borrow £6,000 for an E.L. scheme. There was some opposition.

London.—HAMMERSMITH.—The net profit of the Corporation electricity undertaking for the year just closed, amounts to £519.

POPLAR.—The B.C. has decided to apply to the L.C.C. for a loan of £3,000 in connection with the coal handling plant at the electricity works.

ISLINGTON.—In reference to the reduction in the charges for energy for lighting and power, these are to take effect at once, and the charge for supply for power, heating, &c., is to be ½d. per unit to consumers taking over 50,000 units. Meter rents have been abolished.

Loughborough.—The T.C. has declined to accept the terms and conditions on which it was proposed it should transfer its undertaking to a company.

Loughton.—The T.C. has applied to the L.G.B. for a loan of £3,500 for the extension of the E.L. mains.

Macclesfield.—The Corporation has unanimously approved of an agreement with the promoters of the Macclesfield and District Tramways Bill, whereby the Bill is to include a clause for the transfer of the Corporation E.L. order to the company. The company agrees to pay the Corporation £650 for the order, the latter having the right to purchase the undertaking in 21, 28, 35 or 42 years' time.

Mexico.—Application has been made for an appropriation of 2,000 litres of water per second from the River Chilchota (Michoacán) for hydro-electric power purposes.—*Board of Trade Journal.*

Morley.—A highly successful electrical exhibition has been held at Morley, arranged and promoted by Mr. J. E. Ellis, the borough electrical engineer, and the Corporation electricity department. It was opened by the Mayor on the 5th inst., and during the period of three days it remained open nearly 14,000 people attended. Exhibitors expressed much satisfaction with the amount of business done, and have unanimously petitioned the holding of an exhibition next year on a larger scale, and that it should be for six days. At the opening ceremony Mr. Ellis gave an address on "The Use of Electricity for Lighting, Power, Traction, and other Commercial Purposes."

New Malden.—The U.D.C. has appointed Messrs. Talbot & Stevenson, at a fee of 30 guineas, to prepare and submit a report on the best and most economical means of carrying out its E.L. order.

Shoreham.—The U.D.C. has agreed to the proposal of the Joint Committee to call in an expert, at a fee not exceeding 20 guineas, to advise as to whether the new system of charging for energy submitted by the Brighton T.C.—a flat rate—is fair and equitable.

Slough and Datchet.—The application of the local E.L. Co. for a prov. order to extend its powers from Slough to Iver and other districts, was heard before the B. of T. recently. Opposition was offered on behalf of the Slough R.D.C., but, after a long hearing, the application was granted.

Stockton-on-Tees.—The T.C. has granted permission for the Cleveland and Durham County Electric Power Co. to supply energy to works within the borough, subject to the payment of 1½ per cent. on the revenue during the first five years, and 1 per cent. during the second five years.

Swinton and Pendlebury.—The U.D.C. has appointed a committee to treat with the Lancashire Electric Power Co. for a supply of energy in bulk. The company has advised the Council that the scheme will entail a capital expenditure of £7,621, energy would cost just under 2d. per unit, and distribution about £200. Retailing at 4½d. per unit for lighting, and 1½d. for power, with a 12½ per cent. load, the Council would have an estimated loss on the first year of £400, with a load of 15 per cent. a loss of £290, and with a load of 20 per cent., the receipts would balance the expenditure. The Council is advised that this is a rather sanguine estimate, and one which should be investigated before acceptance.

Torquay.—The L.G.B. has sanctioned the loans applied for by the Council for electric lighting purposes, extension of mains, and for meters.

West Bromwich.—At the meeting of the T.C. last week, it was decided, on the recommendation of the Electricity Committee, to extend the electricity works at an outlay of £5,150.

West Hartlepool.—The T.C. has applied to the L.G.B. for a loan of £1,170 for additional E.L. feeders.

Wigan.—Application is to be made by the Corporation for sanction to borrow £48,200 for electric lighting extensions

TRAMWAY and RAILWAY NOTES.

Australia.—For some time past the South Australian Government has been in communication with the tramway companies in reference to the purchase of the whole of their lines, at a price to be agreed upon. The companies are, in regard to the sale, practically an association. The Premier (Hon. T. Price) has intimated that the Cabinet has decided to offer the tramway companies a price for the whole of the lines.—*Australian Mining Standard.*

Brighouse.—The T.C. has come to terms with the West Yorkshire Tramways Co., and has withdrawn opposition to the company's Bill, enabling the latter to connect Halifax and Huddersfield.

Chicago, U.S.A.—According to the *Times*, the municipal electors of Chicago have decided by a majority of 3,837 votes in favour of municipal ownership of the street railways. The issue of certificates for $75,000,000 (£15,000,000) for the purchase of the existing concerns has also been approved.

Chile.—The *Diario Oficial* of February 15th contained copy of a Decree authorising the substitution of electric for steam traction on the Central Railway between Santiago and Talcar. A central generating station is to be established within 18 kilometres of Rancagua, the motive power for which is to be obtained from the waters of the River Cachapoal.—*Board of Trade Journal.*

Halesowen.—Three of the Light Railway Commissioners the Hon. Alfred E. Gathorne-Hardy, Colonel G. F. O. Boughey, and Mr. H. Allen Steward—held an inquiry on Friday last, respecting the application of the Empire Electric Lighting and Power Co., of Romford, for the transfer of powers obtained by the Halesowen District Council for the construction of light railways in the district. The District Council obtained orders in 1901 and 1902 for the construction of light railways within its area, and under those orders the total capital it was authorised to raise for the purpose of carrying out the work was £95,000. The Council did not raise any of this money, and it appeared to support the application for an amended order, transferring the powers to the company, which in future would be known as the Halesowen Light Railway Co. The application was granted, subject to conditions.

Llandudno-Colwyn Bay.—The B. of T. has granted another month's extension of the Llandudno and Colwyn Bay Electric Railway order, to give the firm who are proposing to take over the line and complete it further time in which to complete the negotiations.

London.—Metropolitan District Railway.—The "centre doors" of the railway coaches have been put out of use, ostensibly for fear of accident, and the space set free will be utilised to provide additional sitting accommodation.

Hammersmith and City Railway.—Good progress continues to be made with the electrification of the Hammersmith and City Railway, jointly worked by the Great Western and Metropolitan. The track work is now approaching completion, and the sub-station at Royal Oak is already in a forward state. The electrification of this line will enable electric traction to be put in operation between Aldgate and Hammersmith, and lead to the final withdrawal of the last remaining steam trains from the Metropolitan and allied systems.—*Railway Gazette.*

L.C.C.—It is reported by the Highways Committee that the total traffic receipts on the Council's tramways for the financial year ended on March 31st amounted to £614,779 from lines worked by electrical traction, and £145,850 from lines worked by horse traction, or a total of £760,629.

Metropolitan Railway.—On Thursday morning last week one of the Metropolitan electric trains travelling in the direction of the City was stopped owing to a failure of the current.

The front and rear coaches of an electric train caught fire at West Hampstead station on the 27th ult.; the train was full of passengers, but no one was hurt.

Mexico.—Plans are being prepared in respect of a projected electric railway between Guadalajara and Chapola.

Newcastle-on-Tyne.—The latest extension of the Corporation tramway system—that to Scotswood Station on the extreme western boundary of the city—was opened on the 6th inst. The great works of Armstrong, Whitworth & Co. stretch their immense length almost alongside the track, and a special line has been laid at one part to accommodate the workmen's cars, which will leave the works at the usual hours. The section was formally opened by the Mayoress of Newcastle-on-Tyne, Mrs. Baxter Ellis, who was presented with a gold chain set with opals and rubies as a memento of the occasion. Some little humour was imparted to the event by the fact that the lines pass through "Paradise." At the banquet which followed, the Sheriff (Mr. Johnstone Wallace) stated that the capital expenditure on the tramways had been £1,150,000; the annual wages bill was between £60,000 and £70,000; they carried 800,000 passengers per week; the cars ran 77,000 miles per week; and the fares totalled £3,700 per week. The Mayor (Alderman J. Baxter Ellis) said that during the twelve months ended March 31st, 1906, they had carried 42,843,330 passengers, as against 39,715,120 in the previous year. Their income had been £197,173, as against £180,631. They had paid in interest no less than £34,218, as against £28,896, and they had paid for redemption £32,924, against £22,638. Most important was the fact that they were working the system with 912 employés all told, as against 1,420 two years ago, 508 employés fewer.

Rochdale.—The receipts on the Corporation tramway system during the past year amount to £42,000, and the expenditure, exclusive of interest and sinking fund charges, to £26,000. The capital charges are heavy, and last year there was a deficit of over £8,000. Messrs. J. G. White & Co., the contractors for the overhead equipment, wrote to the Corporation stating that they had lost about £1,400 on their contract, and asking the Committee and the Corporation to re-imburse them to the extent of half that amount. The Committee decided that it could not see its way to recommend the Council to grant the request. The tender of the Brush Electrical Engineering Co. to supply ten single-deck combination bogie cars has been accepted.

South America.—The Buenos Ayres and Belgrano Tramway Co. has been ordered to remove its lines in the Paseo de Julio, from Maipu to Callao, and to run over the lines of the Metropolitan and Grand National.

The Anglo-Argentine Tramways Co. has inaugurated a new electric service, replacing the Venezuela-Cuyo horse line.—*Review of the River Plate.*

West Ham.—An additional cable is to be laid from the generating station to Stratford for tramway purposes, at an estimated cost of £3,900. The Wanstead Council has definitely refused to allow West Ham, or any company or authority, to construct a tramway across Wanstead Flats. An agreement has been come to with East Ham for the latter authority to connect up the tramway lines in Plashet Lane with the West Ham lines in Green Street.

Wigan.—Application is to be made by the T.C. to the B. of T. for sanction to borrow £13,500 for the purchase and construction of the Abram tramway.

Wimbledon.—An agreement has been come to between the T.C. and the London United Tramways, Ltd., with regard to the construction of tramways in the borough; the company is to pay £4,614 on condition of being relieved from all responsibility with regard to man-holes and sewers.

Wood Green.—The electric tramway extension to the Alexandra Palace was to be opened on Monday.

TELEGRAPH and TELEPHONE NOTES.

Egypt.—The *Zeitschrift für Post und Telegraphie* states that telegraphs were first introduced into Egypt about 50 years ago, and in 1903 there were 4,083 kilometres of line, and 17,486 of wire. Telegrams numbered 1,617,946 in 1902, as against 2,753,488 in 1898. The revenue in 1904 amounted to 1,969,920 fr., and the expenses to 1,477,440 fr., leaving a balance to the good of 492,480 fr. Cairo, Alexandria, Tanta and Zagazig, &c., possess telephonic systems which amounted in 1903 to 486·6 kilometres of line, and 2,696·3 kilometres of wire.

German Cable to Morocco.—It is stated in connection with the concluding negotiations at Algeciras that Germany has assured herself the right to land a cable in Morocco—a right already possessed by England, France and Spain—and it is expected that the privilege will be exercised at no distant date. The natural starting point for the cable would be Vigo, where the German Atlantic Telegraph Co. already has a cable station, and the landing point would be a Moroccan port on the Atlantic Ocean. At present communication between Germany and her African possessions both in the east and west is only possible by means of British cables, but a German cable to Morocco would form the beginning of a telegraph line which in future would place Germany in a position to cable to her colonies in Africa without foreign assistance. In this connection the Berlin *Tageblatt* states it is apparent that in course of time the cable to Morocco will be extended to the Cameroons, whence it will cross Africa through the Congo region, and thus bring German East Africa within its scope. Certain landlines already exist in the Cameroons, while in the east the telegraph service reaches as far as Lake Tanganyika, and the day will come when these two services will be united. The French have for some time past projected a telegraph line which would lead from Algeria across the Sahara, and link up the French possessions on the Congo. It is assumed that the German line, which is to form a connection at Lake Tanganyika with the English landlines between the Cape and Cairo, would also be joined in the Congo region with this French service, which will perhaps not have to be waited for very long. In this way German East Africa and the Cameroons would not only be directly connected together, but also with Germany. A further question for the distant future will be the establishment of direct communication between the Cameroons and German South-West Africa.

Pacific Cables.—The last section of the Manila-Shanghai cable was laid on 3rd inst., and it is expected that direct communication with San Francisco will be opened in a fortnight.

Persia.—The Persian Legation states that there is no foundation for the statement that any difficulty has been made by the Persian authorities with regard to a cable house, owing either to anti-foreign feeling in Teheran, or to the instigation of the Russian Consul. The incident is a purely local one, and merely concerns the site of a telegraph office to be erected by the Persian Government at the desire of the British authorities, in order to link telegraphically the island of Hangam with the mainland, the cost of laying the cables, &c., being defrayed by the Persian Government.

Portugal.—In the year 1904 there were 8,974 kilometres of line and 20,186 of wire, as well 482 telegraph and telephone stations and 15 semaphoric stations.—Telegrams dealt with numbered 5,833,522, of which 1,383,062 were forwarded, 1,639,460 were received, and 2,811,000 were transit telegrams, the total being an increase of 8·1 per cent. on the previous year. Lisbon accounted for the greatest number of telegrams, viz., 1,068,812, then Oporto with 607,318, and Coimbra, Faro and Eevora with 257,560, 80,524 and 73,676 respectively. As regards foreign countries, Great Britain heads the list with 37,123, then follow France with 36,256; Spain with 33,897; Germany with 18,418; South America with 8,925; Africa with 7,843; Italy with 6,912; and North America with 5,913. The various telegraph routes were employed as follows:—395,580 telegrams were sent *viâ* Careavellos; 617,460 *viâ* St. Vincent, and 639,188 *viâ* the Azores. 4,917 telegrams were handed to the Eastern and Western Telegraph Co.'s for Spain, while 1,371 telegrams were received from Spain from these companies. The Semaphoric stations handled 36,888 telegrams.

The only telephone line connects Lisbon to Oporto, and is 333 kilometres in length, the length of wire being 666 kilometres. The total revenue for the year 1904 was 2,150,423 fr., or an increase over 1903 of 27,107 fr.

It is interesting to note that the revenue includes the following collections, viz., for registered code addresses, 39,104 fr.; for forwarding telegrams by express or post, 31,076 fr.; for private telegraph and telephone wires, 32,484 fr.; and net profit on the Lisbon-Oporto telephone line, 8,632 fr.

Transvaal.—The official report of the Transvaal Postal and Telegraph Department for the year ended June 30th, 1905, shows that the revenue from telegraphs and telephones was £154,211, as compared with £138,161 in the previous year.

Wireless Telegraphy.—A sensational account of long-distance telegraphy, as experimentally undertaken by the Berlin Co. for wireless telegraphy, is given at length by the Berlin *Tageblatt*, a representative of which journeyed from Berlin in a motor-car to attend the tests at Nauen, where the company has erected a transmitting and receiving station having a tower 490 ft. high. In brief, it may be stated that the company forwarded a telegram from the representative to the company's station in San Francisco for delivery to the Berlin newspaper's correspondent in the American city. Later in the afternoon the editorial offices of the newspaper received a cable from the correspondent repeating the text of the message sent by wireless telegraphy. A second wireless telegram had also been forwarded to Tsingtau, China, and a reply by cable also came to hand, a little later in the same day, which was sent by the company's staff at the wireless station at Tsingtau, by means of the ordinary cable service. The latter cable expressed thanks for greetings, and announced that the station had not been "spoken to" since the arrival of the message. It is further stated that the wireless telegraph company has equipment on the way, to establish communication with Samoa; and that, as it has become possible to concentrate the transmission of energy, the Telefunken system now allows of transmission over any distance whatever. The two experiments in question are reported to have taken place on March 31st; the report on the subject appeared in the Berlin newspaper on April 1st, an inauspicious, but perhaps appropriate date.

A wireless telegraph station is to be fitted up at Zamboango on the island of Mindanao in the Philippines, to be in communication with the island of Joko, about 150 kilometres distant. A submarine telegraph cable already exists between the above places, but owing to the great depths of the sea, which is full of coral banks, and very strong currents, it is frequently interrupted, so that telegraphic communication is most uncertain.

The Cunard liner *Campania* arrived at Liverpool on the 7th inst. When the vessel was 2,350 miles from the English coast communication was established with Poldhu, in Cornwall. When 1,850 miles from Poldhu, messages were received both from Europe and from America.

The German Postmaster-General has announced that it is not intended to use the new wireless station at Norddeich, which is now almost ready for the transmission of messages, as an exchange between Great Britain and other European countries. The new station is declared to be the most efficient in the world, having a tower 213 ft. high, and covering a circuit of nearly 1,000 miles. Except when, as in the case of Great Britain, any country is for some reason excluded from participation, messages can be conveyed on the "Telefunken" system between Germany, Switzerland, France, Great Britain, Denmark, the greater part of Italy, Sweden, Norway, portions of Spain, the Balkan Peninsula and Russia. Vessels will be able to communicate through the station when as far out on the Atlantic as 12° west of Greenwich.

The Admiralty has decided to make a reduction of 400 in the signalling branch, due to the success of wireless telegraphy, which will be more generally used henceforth in the Navy.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
Trinidad-Demerara (No. 1.)	Aug. 26, 1901	..
Dominica-Martinique	May 7, 1902	..
St. Lucia-Martinique	May 7, 1902	..
Reissa-Issa (Yemen) Camaran	Oct. 22, 1902	..
Cayenne-Pinheiro	Aug. 13, 1902	..
Port Arthur-Chifu (Closed)	Mar. 7, 1904	..
Tarifa-Tangier	Jan. 18, 1904	..
Jamaica-Colon	Jan. 5, 1905	..
Cadiz-Tenerif	July 20, 1905	..
St. Vincent-St. Lucia	Feb. 16, 1906	..
Tangier-Cadiz	Feb. 18, 1906	..
Landlines.		
Puerto-Barrios	Aug. 28, 1902	..
Communication with Brazil *via* Galveston	July 18, 1905	April 5
Bachkale-Deliman	Feb. 12, 1906	..
Bagdad-Bassorah	April 6, 1906	..

CONTRACTS OPEN and CLOSED.

OPEN.

Belfast.—April 16th. Coal and ash conveying plant, bunkers and chain-grate stokers. See "Official Notices" March 23rd.

Belgium.—May 1st. The municipal authorities of Montigny-sur-Sambre are inviting tenders until May 1st for the electric lighting of the town. Particulars may be obtained from, and tenders are to be sent to, Le Secretariat Communal, Montigny-sur-Sambre.

Bristol.—April 18th. Electric lighting of Tobacco Warehouse, Cumberland Basin, and the maintenance of the work for twelve months after completion. Secretary of Docks Committee, £3 deposit.

Chorlton.—April 18th. The Guardians invite tenders for the electric lighting of their workhouse and hospitals at Withington. Mr. G. R. Peers, A.M.I.E.E., 16, John Dalton Street, Manchester (deposit, three guineas).

Darlington.—April 30th. Condensing plant for the Electricity Works. See "Official Notices" April 6th.

Darlington.—April 30th. Counter current jet condensing plant, complete with piping and cooling tower, for the electricity works.

Dundee.—April 14th. General stores for the electricity department.

Glasgow.—April 23rd. Cables, wires, meters and carbons, for the electricity department. See "Official Notices" April 6th.

Hull.—April 19th. Coal-handling plant, condensers, pumps, pipework, &c., for the Electricity Works. See "Official Notices" April 6th.

Salford.—April 21st. One 750-KW. steam turbo-generator and condensing plant. See "Official Notices" March 23rd.

Servia.—April 20th. The Post and Telegraph authorities in Belgrade are inviting tenders for the supply of 50 tons of bronze wire for the telegraph service.

South Shields.—April 18th. Ten open staircase-type double-seat motor-cars with "Brill" trucks. See "Official Notices" April 6th.

Sydney (N.S.W.).—The *Australian Mining Standard* says that the Sydney City Council will shortly call for tenders for additions to its electric lighting plant.

Wallasey.—April 18th. Boilers, 500-KW. steam alternator (single-phase), also extensions to electricity works buildings, for the U.D.C. See "Official Notices" March 23rd.

CLOSED.

Erdington.—The U.D.C. has accepted the tender of Mr. G. Law, of Kidderminster, for the construction of the tramway from Salford Bridge to the Sutton boundary, at £35,210.

London.—BATTERSEA.—The B.C. has accepted the tender, at £788, of Messrs. Oliver & Co., for 70 arc lamps, complete with raising and lowering gear.

FULHAM.—The B.C. has accepted the following tenders for annual supplies in connection with the electricity undertaking:—

Packings, jointings, &c., Messrs. H. Edwards & Co.
Street lighting goods, Messrs. J. Gibb & Co.
Fuse wire, &c., the Municipal Supplies Co.
Carbons, Messrs. Geipel & Lange.
House cut-outs, &c., British Insulated & Helsby Cables, Ltd.

LLINGTON.—The Guardians have accepted the tender of Messrs. Pyke & Palmer for supplying electrical fittings and sundries.

Luton.—The T.C. has accepted the tender of W. T. Glazebrook's Cable Co., of Bradford, for the supply of distributing mains.

Southend-on-Sea.—The T.C. has accepted the tender of the Brush Electrical Engineering Co., Ltd., for providing and fixing new Brill trucks, equipments and controllers, to three tramcars, at half the actual cost, £450.

Walsall.—The Electricity Committee has accepted the following tenders:—

Thomas Parker, Ltd., a high pressure continuous current dynamo, £894.
Belliss & Morcom Ltd., a three-crank engine, £1,240.
Stirling Boiler Co., Ltd., a tubular boiler, £922.

West Ham.—The Corporation has accepted the following tenders in connection with the electricity undertaking:—

Coal, 10,000 tons (delivered within 12 months), Newdigate nutty slack, Messrs. Kaye, Son & Co., 9s. 3d. per ton, f.a.s.; 2,500 tons Riddings nutty slack (to be delivered from October to March, 1907), Messrs. Phillips & Co., 10s. per ton, f.a.s.
Second motor-generator, General Electric Co., £1,150.
Annual supplies (cable), British Insulated and Helsby Cables, Ltd.; motors, General Electric Co., Ltd.; transformers (except street tanks), the British Electric Transformers Co.; meters, British Westinghouse Co.; house cut-out boxes, the Universal Electric Manufacturing Co.

West Hartlepool.—The Corporation has accepted the Sunbeam Lamp Co.'s tender for Reyrolle motor panels and starters for the year ended March 31st, 1907.

FORTHCOMING EVENTS.

Friday, April 20th.—At 8 p.m. Junior Institution of Engineers. Mr. W. A. Tookey, on "Recent Developments in the Construction of Suction Producer Gas Plants."
North-East Coast Institution of Engineers and Shipbuilders' Meeting.
Saturday, April 21st.—At 7.30 p.m. Birmingham and District Electric Club. Mr. W. Smith on "Submarine Cables."

NOTES.

Institution Notes and Lectures.—INSTITUTION OF CIVIL ENGINEERS (STUDENTS).—On Thursday last week, the 31st annual dinner of the Students Inst. C.E. was held at the Trocadero; Sir Alexander Binnie, President of the Institution, was in the chair, and there was an exceptionally good attendance. After the loyal toasts, Mr. H. E. Steinberg, chairman of the Students' Section, proposed "The Institution, the Secretaries of the Institution, and our Guests" in a neat speech, in which he laid stress on the great benefits derived by the students from the assistance given them by the Institution in various ways. Speaking of technical education, he said that the entrance examinations of technical colleges should be fairly stiff, to ensure that only good material for training might be admitted, and these examinations should be oral, to ensure that the choice of material might be guided by the type of the candidate rather than his knowledge.

In his reply, Sir A. Binnie impressed upon the students that they were Englishmen, and deplored the tendency on the part of certain persons to depreciate the British race; they were not inferior to foreign nations—but to maintain their superiority they must go out into the great Empire and assert their position after the manner of their forerunners. Lieut. Osborn, R.E., also replied on behalf of the Royal Engineers, and declared that the Army cordially welcomed co-operation in the defence of the Empire, which might be necessary in the immediate future.

Prof. J. D. Cormack, in a humorous speech, proposed "The Students," and Mr. P. A. Spalding, the hon. secretary, briefly acknowledged the toast on their behalf.

Farban's Viennese Band performed a programme of music during the meal, and afterwards the Follies gave their popular performance. There was no doubt that enjoyment was general.

A lecture on "Rapid Methods for Producing Electrotypes" was given by Mr. Sherard Cowper-Coles at the London County Council School of Photo-Engraving and Lithography, Bolt Court, Fleet Street, E.C., on Thursday, 5th inst. He described in detail the improvements that have taken place in electrotyping from time to time, which has finally resulted in electrotypes being produced in from five to ten minutes, as against eight to twelve hours by the old process.

On 4th inst. the Right Rev. Monsignor Molloy, D.D., D.Sc., delivered a third and concluding lecture on "Electrical Induction" in the theatre of University College, Dublin.

A paper on "Electric Driving in Workshops" was read on the 5th inst. by Mr. Ellis H. Crapper, at the engineering department of the University of Sheffield, before members of the Association of Yorkshire Students of the Institution of Civil Engineers.

Growing Crops by Electricity.—The *Stratford-on-Avon Herald* says that an interesting experiment is being conducted on land at Iron Cross, between Evesham and Alcester, electricity being used to promote the growth of farm crops. The electricity is discharged from overhead wires suspended 16 ft. above the ground, from poles 100 yards apart. The current is generated by a dynamo driven by a 3-H.P. oil engine at the farm buildings, and is transformed to a high pressure and distributed over the wires, the current going to earth through the air, and consequently through the crop that is growing beneath the wires. In conversation with a Press representative, Mr. J. E. Newman, the electrical engineer engaged, referred to the experiments carried out by the late Prof. Lemstrom, of Helsingfors University, who used a comparatively low-tension electricity, and ran his wires only a short distance above the surface of the ground. Mr. Newman said that last year he carried out some experiments at Bitton, near Bristol, and distributed a current over indoor cucumbers and outdoor strawberries, cabbages, beans and peas, and he considered the results on the whole encouraging. Now he had 19½ acres of land under the wires, 12½ of wheat, and about seven of barley, with some small plots of various crops. Mr. Newman said he should be disappointed if he did not obtain an increase in the yield of grain of 25 per cent., with a corresponding increase in the straw, and he hoped that the wheat would be of a higher quality than usual, and as good from a milling point of view as the American wheat. All previous experiments of the kind have been carried out with the electricity derived from influence machines. This is the first time that a dynamo has been used in connection with experiments of this kind.

Niagara Falls.—The report of the American members of the International Commission for the Preservation of the Niagara Falls recommends that legislation be passed, based on a treaty between America and Canada, to prevent further depletion of the water, to maintain the present scenic effects, and to regulate the electrical supply companies which are using the Falls for power. It is proposed to limit the diversion of the waters on the American side to 28,500 cb. ft. per second, and the diversion of the Canadian side to 36,000 cb. ft.

The Miller Signalling System.—An installation of this system has just been completed on the Belgian State Railway, on the main line towards Cologne, between the stations of Haren, Dieghem, Saventhem and Nooseghem, a distance of a little over 7 kilometres; it is stated to be the first *purely* electrical system of signalling that has been practically established in Europe; there is no third wire, no rubbing contact, the rails alone being the conductors. The

insulated joints are the ordinary wood and leather ones used by the State Railway, and the rails are bonded with a simple steel wire. On the cab of the locomotive the ordinary Miller signal, as used in the United States, is adopted, the only difference being that in place of the red and white lights, a steam whistle is thrown into circuit the moment there is danger ahead, so that the engine driver has both a visible and an audible signal before him; it is arranged that should there be any obstruction two sections ahead, there is an immediate indication of danger. Should a point be left open on a siding, the Miller system goes to danger on the locomotive. Another advantage of the system is, should anything go wrong—say, with the batteries—the Miller system shows danger. However foggy the weather, the engine driver can advance with perfect confidence if his signal is clear on his locomotive. Many practical tests have been made on both express and slow trains, points left open on purpose, &c., and the system has proved a complete success. Nine locomotives are already equipped with the Miller system.

The engineer-in-chief is Mr. Douglas Wells, M.I.E.E., of Brussels, who has carried out the work with his assistant, Mr. Ant. Cornet, to the satisfaction of the Government and to the owners of the Miller patents in Europe, Mr. A. S. Morrison, of Duke Street, London, and his colleagues.

Care Comes with Age.—Care here is used in the sense of carefulness, and is the burden of a letter from Sir George Livesey to the *Times* (March 24th), wherein he confutes the statement of the Member for Hanley in debate, that "great limited companies had not much regard for workmen who were advanced in years, and dismissed them rather than run the risk of having to pay compensation for injury."

Sir George takes him on this ground, and proves well enough, by the tables given below, that, in the case of his own company, which is "great" beyond doubt, it is neither a fact that old men are discharged for fear of claims for injury, nor that they are, in fact, more liable to run into danger than younger men, but that, on the contrary, they are 30 times safer than the men between 20 and 40 years of age, who form the bulk of the employés

Visitors to American workshops are taken to the cemetery to see men over 40, so one looks with pleasure at the 18 per cent. of workmen between 40 and 50, and the 7½ per cent. between 50 and 60, who are under the beneficent rule of Sir George Livesey.

No electric light works, however large, could find employment for anything like the 5,000 to 6,000 men who are required to make and distribute gas for the South Metropolitan Gas Co., so that the corresponding figures could not be so striking, but we should fancy that the risks of accident occurring in or about the stations are even smaller than in a gas-works. The nature and operation of the machinery would suggest it.

Age.	Numbers of		Percentage of accidents.	
	Men.	Accidents.	In the eight years.	Average per annum.
Up to 20	398	117	29·4	3·7
,, 30	1,742	718	41·2	5·15
,, 40	1,941	734	37·8	4·7
,, 50	1,016	389	38·3	4·8
,, 60	427	128	30·0	3·75
Over 60	191	28	14·7	1·8
	5,715	2,114	37·0	4·6

Or, putting it another way—

Up to	20	30	40	50	60	Over 60 years.
Per cent. of men ..	7	30½	34	17½	7½	3½ = 100
Per cent. of accidents ..	5½	34½	34½	18½	6	1¼ = 100

These figures have been derived from the records of the mutual accident fund over the last eight years, and they ought to do something towards persuading those employers who have no use for a man after he is 40 that, viewed as a source of expense in the way of compensation, he is relatively innocuous. The table, indeed, makes us wonder whether a workshop full of septuagenarians might not pay better than one full of callow youths of 40.

German Electrical Trade in 1905.—The report for 1905 of the Association for the preservation of the mutual economic interests of German electrical engineering (Verein zur Wahrung gemeinsamer Wirtschafts Interessen der Deutschen Elektrotechnik) states that the year provided exceptional employment, which even exceeded that of the high period of prosperity in 1900, but corresponding profits were not realised, owing to the large advance in the prices of raw materials. As to details of the extraordinary activity, the report refers to the mining industry as having occupied the first position by reason of the extension in the use of electric power for working winding engines, pumps and ventilating appliances, and for haulage and lighting purposes. Next comes the iron industry, from large works to hardware makers, and these are followed by the textile industry and other branches by extensions of central stations and erection of new works, railway experiments and the increased application of electricity to agricultural operations in respect of traction purposes and the driving of machinery. The value of the exports of electrical products, according to the official statistics, has been as follows in the past two years:—

	1905.	1904.
Official statement of value ...	£3,750,000	£3,250,000
Estimated value if switchboard apparatus, arc lamps, insulated wire and heating and cooking appliances are included	£5,000,000	—

The estimated value is that given by the Association, as the Statistical Board does not specifically enumerate the manufactures in question. The larger demand last year was mainly from European countries, which were followed by Central and South American States and South Africa. As, however, the export to certain European countries was stimulated by the coming into operation of new treaties of commerce on March 1st, 1906, the report does not consider that last year can be regarded as a normal year, but that the export activity will soon perceptibly decline. The electrical industry employed 82,000 workers in 1905, as compared with 72,500 in the preceding year, and the number of firms increased from 225 in 1904 to 250 last year. The report ventures to suggest the formation of syndicates, which, notwithstanding the multifarious nature of the industry, could be constituted if all the interested firms would agree to co-operate with each other in the promotion of uniformity of action in respect of prices and possibly also of production,

County Councils' Association and Provisional Orders for the Supply of Electricity.—At a meeting of the Executive Council of the County Councils' Association held at the Westminster Guildhall on the 4th inst., the Parliamentary Committee reported as follows:—The Committee considered a case of difficulty arising in Northamptonshire in connection with a provisional order for the supply of electrical energy. Communications as to difficulties of a similar nature were received from Dorset and Worcestershire. It was resolved that it is desirable that a deputation be sent from the Executive Council to the Board of Trade; to request them to adopt for insertion in all electric power and light Acts and provisional orders which affect County Councils:—

"(*a*) The 'Lancashire Clauses,' together with the following clause: 'The Council shall not be liable to pay to the company any compensation for injury done to any pipes, wires, cables or electric mains by the execution of such works, or for loss occasioned thereby, or for the reasonable exercise of the powers so vested in them as aforesaid.'

"(*b*) The following clause: 'Except as in this Act otherwise expressly provided, no electric lines shall be placed overhead, along, across, or by the side of any road repairable by the County Council, or any bridge under their jurisdiction or repairable by them, or any approach thereto, without the consent of the County Council, to be given or withheld at their absolute discretion.'

"(*c*) Such other clauses for the protection of roads as have been included in the Shropshire, Worcestershire and Staffordshire Electric Power Acts, 1903 and 1905."

On the motion of Sir J. Hibbert, the Duke of Northumberland, Lord Belper, Viscount Valentia, Mr. H. S. Whitbread, M.P., Sir R. Littler, K.C., and five others were appointed as deputation.

Liability for Accident.—The more stringent provisions of the new Workmen's Compensation Bill will undoubtedly have the effect of furthering the cause of insurance. Herein lies a danger. There can be no doubt that many employers, more from carelessness, perhaps, than from heartlessness, look upon the premiums they pay to the accident insurance company as absolution from all further responsibility in respect of the safety of their workmen. They are, of course, exposed to the visits of the Home Office inspectors, whose duty it is to see that machinery is properly fenced, and that due provision is made for the elimination of dust and harmful vapours. But every workshop manager knows that there is a great difference between the health and security from accident in one workshop and that obtaining with others. In some cases risks are taken so that work can be expedited; in other cases the disposition of machinery is less safe than it may be possible to make it. Yet in all cases the rates of premium are equal in the same trade or business. It should be possible to make an allowance in favour of those workshops which stand higher than the average, in order that encouragement may be given to endeavours that tend towards diminished risk. To this end it should be possible for a workshop to secure a classification somewhat on the familiar system adopted at Lloyd's for shipping. In this way the premiums payable for accident insurance would be regulated in accordance with the safety and general excellence of the works.

Employers' liability for accident is becoming an exceedingly onerous matter that can only be dealt with by the smaller firms on the insurance principle. A large firm can, to some extent, insure itself, though we are inclined to question the advisability of this, since it were better that all should come under the same category. Very many accidents are due, if not to actual wilful intention, yet to culpable negligence, and it should be possible to punish a man who suffers any injury as a result of downright carelessness and disobedience of orders and rules. Ultimately it would appear that all accidents will be cared for by the State, for to that end the employers' liability must trend. In such case benefits ought not to be confined so strictly to the working man so-called. As things now are, the independence and manhood of the country are being sapped by all kinds of coddling, but why should the one class be alone coddled at the expense of other classes which are less well-to-do, though several grades higher up the social ladder?

London Chamber of Commerce.—The annual meeting of the London Chamber of Commerce was held on Tuesday last week at the offices, Oxford Court, Cannon Street, under the presidency of Mr. T. F. Blackwell; the report, which was adopted, stated that the chairman (Mr. C. P. Sparks) had not found it necessary to call the electrical section together during the year.

J. Stone & Co., Ltd., v. The General Electric Co. (1900), Ltd.—In the Chancery Division of the High Court on Friday before Mr. Justice Swinfen Eady, Mr. Eve, K.C., said he had a motion on behalf of the plaintiffs to restrain the defendants from selling electric lamps with the name of Stone, or Stone's patent, upon them, they not having been made under the authority of the plaintiffs. Mr. Maugham, for the defendants, said he offered a perpetual undertaking in the terms of the notice of the motion, also an account of profits and costs of the action. The only question was whether there should be an undertaking or an injunction. He offered an undertaking. The injunction was only pressed for for the purpose of advertising the matter. It was not fair that this should be advertised. Mr. Eve said it was not of the slightest importance whether he got an undertaking or an injunction so long as he received the relief he asked for in the writ. He would be satisfied with a perpetual undertaking. His Lordship made an order in the form agreed to between parties.

Appointments Vacant.—Draughtsman for the Egyptian State Railways; junior shift engineer for the Birkenhead electricity department (35s.).

Surging in High-Tension Lines.—Some researches upon the electrical oscillations, or surgings, in the electrical transmission lines of the high-tension circuit of the Mediterranean Coast Power Co. made by Mr. C. David with the aid of a Blondel-Carpentier oscillograph, are published by the Canadian Society of Civil Engineers, a paper having been read upon the subject by Mr. J. A. Herdt on November 2nd, 1905, and illustrated by many interesting curves.

The transmission line consists of two lengths of three overhead conductors conveying three-phase current, with an eight-mile three-conductor lead-covered cable in between, the whole length of the line being 40 miles. A three-phase 600-K.V.A. 25-cycle 11,000-volt alternator, driven by a 900-H.P. horizontal turbine, provided the power, and the station switchboard was equipped with high-tension oil switches, three-pole air knife switches being also provided; the no-load E.M.F. wave of the alternator was nearly sinusoidal. Experiments were conducted by making and breaking the charging current at the sending end of the line with an air switch, the charging current being 5 amperes at 8,900 volts, and these were repeated with the oil switch.

From the results obtained, it is deduced that there is danger of over-voltage when a transmission line is thrown on the generator bus-bars, except at or near the moment when the impressed E.M.F. is zero, and there is no danger of over-voltage when the line is switched off, as the charging current is usually small; but there is danger of over-voltage when a loaded line is switched off the high-tension bus-bars, and an oil-break switch is likely to prove less dangerous than an air switch.

In all cases the surging of the E.M.F. wave ceased during the first complete period on switching in with the oil switch, and the oscillations were kept up for at least two periods after the opening of the circuit when the air switch was used.

When a 4-mile three-conductor lead-covered cable was connected up with a transformer on open secondary, the impressed E.M.F. waves showed little or no oscillation, whereas the current waves showed very violent fluctuations, which took a considerable time to damp down.

The records were taken on a continuous film 4 ft. 6 in. long × 3 in. wide, so as to include conditions not only during, but also before and after surging.

Coal Testing in the United States.—The U.S. Government has made a considerable number of official tests upon the fuels of the various States, and these it is intended to continue under the supervision of the Geological Survey Department. The United States are the largest fuel-producing nation, and it is hoped that these fuel tests will do something towards promoting economy in the use of coal. A preliminary report has already been issued, from which interesting facts may be gathered. Thus it is stated that by the conversion of solid fuel into gas and the use of that gas in gas engines, the output of power will be doubled, or it will become even two and a half times greater than when the same coal is used to produce power by means of steam plant. It is further stated that where coals are rated by their steam-producing capacity, the poorer coals will, when put through gas producers, give results superior to those of the better coals, as might be perhaps anticipated, seeing that a poor but "dry" coal may often be better as the raw material for the gas producer than a fat or rich coal, which may give off much tar. As regards lignites these when reduced to gas will give out more power through gas engines than will steam coal burned under boilers. It is also found that by washing a coal it may be improved, both in ash and sulphur when used or made into coke or briquettes, and it is also found that the addition of coal-tar pitch to a dry non-coking coal will enable that coal to produce a fair coke, the pitch evidently supplying to the coal that quality of fusion which enables it to form coke. A grant of $200,000 has been made, and coal owners sending coal for test have to send it carriage paid, but the railroad companies have borne a good deal of this charge by carrying test quantities free.

No such tests have, we believe, even been undertaken authoritatively or otherwise in this country, though large numbers of analyses have been made, and many have been published by the *Colliery Guardian* in pamphlet form. These are, however, by no means complete, and are lacking in respect of the calorific capacity. So much juggling is done with boiler tests by erroneous statements of the calorific capacity of the coal used, that it would be a good thing were this figure published for a number of the better-known seams. Thus, cases may be found where, after deducting the ash, stated to be present, the calorific capacity is less than that of carbon alone, and this with, perhaps, all true coal, is very improbable. Calorimeters are far from reliable if of the ordinary types, and great caution is necessary in accepting casually-obtained results from these instruments.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the* ELECTRICAL REVIEW *posted as to their movements.

Central Station Engineers.—Gillingham (Kent) T.C. has appointed the borough electrical engineer for a further term of three years at his present salary, £350 a year and half the fees of two pupils (£50 per annum). The E.L. Committee had recommended an increase of £5 per annum. They have also appointed Mr. A. McADAM, of Erith, as shift engineer. There were 43 applicants.

The Stalybridge, Hyde, &c., Tramways and Electricity Board has increased the salary of Mr. AMBLER, station superintendent, to £175 per annum, rising by £5 a year to £200.

Mr. F. E. WILKINSON, late assistant electrical engineer at York, has been appointed resident engineer and manager for the Electric Supply Corporation, Ltd., at Falmouth, as from April 8th.

The Newmarket U.D.C. has appointed Mr. FRANK A. SIMPSON, engineer of the Newmarket E.L. Co., as chief officer of the Fire Brigade.

Tramway Officials.—By 23 votes to 19 Rochdale T.C. has decided to grant an honorarium of £500 to Mr. S. S. PLATT, borough surveyor, for services rendered in connection with the reconstruction of the tramways.

The Ilford U.D.C. has increased the salary of Mr. G. R. SPURR, its tramway manager, from £250 to £300 per annum, rising to £400 by £50 a year.

The Croydon Council has appointed Mr. H. B. HARRIS, A.M.I.E.E., to be mechanical and electrical engineer for the tramways at £208 per annum; Mr. C. G. FOSTER, at present in the employ of the lessees, has been appointed out-door superintendent at £182 per annum.

General.—Mr. G. H. ROGERS, manager of the Ramsgate district for the National Telephone Co., is leaving for Montreal, Canada. He has been presented with a gold signet ring by the operating and instrument room staff. Mr. Rogers has obtained an appointment in the Montreal telephone service.

NEW COMPANIES REGISTERED.

Carnarvonshire Electric Traction Syndicate, Ltd. (88,230).—This company was registered on March 31st, with a capital of £1,000 in £1 shares, to carry on the business of contractors for public works and conveniences of all kinds, tramway, railway, omnibus and van proprietors, carriers of passengers and goods, suppliers of electricity for light, heat, motive power, telephonic, telegraphic, industrial and other purposes, accumulator and dynamo manufacturers, &c. The first subscribers (each with one share) are:—H. P. Dakin, 130, Holmesdale Road, South Hornsey, S.E., clerk; R. J. Muggleton, 14, St. Helen's Place, E.C., clerk; W. A. Hill, 1, Colwell Road, East Dulwich, S.E., shorthand writer; R. G. Cheshire, 14, St. Helen's Place, E.C., clerk; A. G. Coggan, 14, St. Helen's Place, E.C., clerk; W. J. Hill, 14, St. Helen's Place, E.C., clerk; and A. E. Bullard, Burleigh, Chudleigh Road, Brockley Grove, S.E., clerk. No initial public issue. The number of directors is not to be more than five; the subscribers are to appoint the first.

Simplex Conduits, Ltd. (88,290).—This company was registered on April 4th, with a capital of £100,000 in 10,000 6 per cent. cumulative preference shares of £5 each, and 50,000 ordinary shares of £1 each, to acquire and carry on all or part of the business of electrical and mechanical engineers and manufacturers of electric fittings and apparatus now or recently carried on by the Simplex Steel Conduit Co, Ltd., in Birmingham, London and elsewhere. The first subscribers (each with one share) are L. M. Waterhouse, Bindown, Hampton Wick, engineer; H. Huggins, Wicksted, Leamington, manufacturer; F. Huggins, Hill House, Lapworth, manufacturer; H. C. Pinsent, 6, Bennett's Hill, Birmingham, solicitor; H. R. Hodgkinson, 6, Bennett's Hill, Birmingham, solicitor; G. J. Withington, 9, Bowyer Road, Saltley, Birmingham, clerk; and H. G. Silk, Hewell Road, Barnt Green, Birmingham, clerk. Minimum cash subscription, one-quarter of the shares offered to the public. The number of directors is not to be less than two or more than seven; the first are H. Huggins, F. Huggins and L. M. Waterhouse, with power to appoint others prior to the statutory meeting; remuneration, £100 each per annum.

CITY NOTES.

Kidderminster and District Electric Lighting and Traction Co.

THE eighth ordinary general meeting of the shareholders of this company was held on Monday at the offices, Donington House, Norfolk Street, Strand, Mr. W. L. Madgen presiding.

In proposing the adoption of the report, the CHAIRMAN said the accounts showed a considerable improvement over those of the

preceding year. The profit for the year, before allowance for debenture and other interest, amounted to £3,351, an increase of £784; and after deducting the debenture and other interest, the profit was £1,180, an increase of £310. After allowing for those payments, and deducting the sum of £780, being the total cost of the Bewdley Light Railways Order, which the shareholders were informed at the last meeting had been abandoned, there remained a balance of £1,643, which the directors recommended should be applied to paying the dividend on the cumulative preference shares, amounting to £1,500, leaving £143 to be carried forward. There had been a fair increase in the number of installations connected to the mains, but until the trade of the district improved they could not make much progress. The prospects of the Kidderminster carpet trade did not appear very hopeful. A number of factories had been shut down, and the weavers had gone, with their looms, to America and Canada. Their charges for electricity were very low and compared favourably with those charged in the largest towns in the country. With regard to the accounts of the Kidderminster and Stourport Tramway Company, in spite of the decrease of £376 in the receipts, there was an increase of £224 in the net profits. That result had only been obtained by effecting every economy possible in the operation of the lines. The percentage of expenses to receipts was 59 per cent.—a decrease of 5 per cent. as compared with the previous year. The decreased receipts were due partly to the increased trade depression and partly to the competition of the Great Western Railway cars. Every endeavour was made to increase the traffic. Circulars and guides were sent out all over the Midland district with a view to inducing excursionists to visit Kidderminster and Stourport.

Sir Ernest Spencer seconded the motion, and the report was adopted.

Cuba Submarine Telegraph Co.

The directors' report for the half-year ended December 31st, 1905, says that the total receipts were £14,648, while the expenses amounted to £6,257, leaving a balance of £8,390, to which has to be added £6,032, brought forward from last account, giving a total of £14,422 to be dealt with. The sum of £1,818 has been added to the reserve fund, which now stands at £87,000. The dividend on the preference shares will absorb £3,000, and leave £9,604, out of which the directors recommend the payment of a dividend at the rate of 5 per cent. per annum on the ordinary shares, free of income-tax; the balance, £5,604, being carried forward to the current half-year. The cables continue in good working order. The claim against the United States Government for payment of the cost of repairing the damage done to the cables during the Spanish-American war is still unsettled.

Austrian Kabelfabrik Actien Gesellschaft.

The directors of the Kabelfabrik Actien Gesellschaft, of Vienna and Pressburg, have forwarded us a copy of their report for 1905, which recommends the payment of a dividend at the rate of 8 per cent., as compared with 7 per cent. in 1904. This result is regarded as all the more favourable as the work of, and considerable expenses incidental to, the transfer to the new factory buildings in Vienna, are included in the year, and this explains the reduction in the profits from the Vienna undertaking. In addition to the new factory, the company has established at the Pressburg factory a new department for the production of paper insulating tubes. The directors state that the manufactures enjoy the complete approval of customers, and the sales continue to increase. Unfortunately the new equipment and the expansion in the turnover have increased the bank debt, and this raises the question of strengthening the company's capital. During the year both factories were fully employed in the execution of orders for underground lead-covered cables, the contracts being with both State Administrations of the Monarchy, various town authorities in Austria and Hungary, and the electrical engineering firms; whilst large orders were also received from abroad. Most of the work was completed in 1905, and laying in the current year has to be carried out of 7,000-volt cables at Trondjem, cables for the Rotterdam tramways, 6,500-volt cables for St. Petersburg, cables for the Cairo tramways, the Brunn telephone network, and telegraph and telephone cables for the Bosruck-Klamm and Rothwein Tunnel. The accounts show a net surplus of 262,656 kronen, which, after making provision for the legal reserve fund, remuneration of directors, and appropriating 10,000 kronen for the officials and workmen, allow of the payment of the higher dividend already mentioned.

Buenos Ayres and Belgrano Electric Tramways Co.

The annual general meeting was held at Winchester House on Thursday, April 5th, Mr. J. B. Concannon presiding.

In moving the adoption of the report, the Chairman said that the directors had reduced the dividend which it was proposed to pay. One reason for this was, that experience had taught them that the question of renewals would in the future become a most important matter, and it was felt that they should act in a most conservative manner in regard to it. In view of the fact that they had run 22 per cent. more in mileage, and that that had added very considerably to the wear and tear of their rolling stock, the directors felt bound to pay more attention to the question of renewals. They had had to add very materially to the number of their cars; they now had 15 more cars, and there were another 10 on order in this country. It was prudent, therefore, that there should be a decrease in the dividend. Speaking of his recent visit to South America, the Chairman said that he had been much interested in all he saw. That company's line was one of the best in Buenos Ayres. He found that for some years they had had more or less competition from the Buenos Ayres electric tramways, and also from the Metropetana line, but the result, so far, had been that they were holding their own. The question of the reduction of fares in relation to this competition had been considered, and they had come to the conclusion that it was the best policy to keep the fares as they were, and to increase the distances which the fares covered. On the "lower" line, which had always been the poorer line, the fares had been reduced from 20 to 15 cents and from 15 to 10 cents, and the results had been most satisfactory. Of course, if they had had no competition at all, their traffic would have gone up by leaps and bounds; indeed, most likely they would not have been able to have dealt with it; but, as things were, he felt that they were bound to be satisfied with the results. It was impossible to anticipate the future accurately, but his opinion was that Argentina would become a second United States. He meant within the next 20 or 30 years. The main lines of that company were in the best streets of Buenos Ayres, and, notwithstanding the competition, he thought that they were on the road of continued progress. Of course, with the increase in the prosperity of a country, there was the liability of an increase in wages and a demand for shorter hours, but, on the whole, he considered the prospects very good.

The report having been adopted,

Mr. W. J. Hamilton, K.C., in moving the re-election of the chairman and Mr. Wm. Wilson to the board, said that since he had been elected to the board himself he had felt that he should be in a better position to understand the company's affairs if he paid a personal visit to Buenos Ayres. He went, and could assure the shareholders that it was a splendid city. Having been over the competitive route, he felt that most people would prefer going over the route belonging to that company. While he was out there he discussed certain legal questions with the lawyers representing the municipal authorities, and he could say that, in his opinion, the company would have no difficulty in retaining the benefits which they had under their concessions.

Wycombe (Borough) Electric Light and Power Co.

The directors' report for 1905 says that considerable progress has been made during the year, the connections having risen from 37,383 to 40,983, being an increase of 3,600 8-c.p. lamps. During the year 2,000 £5 ordinary shares have been issued and paid up, and £2,100 debentures. The result of the year's trading, including a balance of £126 brought forward, shows a profit of £4,437, and after paying interest on debentures and loans and a proportion of the cost of Exhibition expenses amounting to £2,518, there remains a balance of £1,919. The directors recommend a dividend at the rate of 4 per cent. for the year, which will absorb £1,600, that £200 be placed to the reserve fund for renewal of plant, £100 to reserve for bad and doubtful debts, leaving a balance of £19 to be carried forward. Edmundson's Electricity Corporation have again waived their claim for a portion of the interest due on overdue accounts.

Waterloo and City Railway Co.

At a special meeting on Thursday last week, Sir Chas. Scotter said that, in connection with their Bill for the L. & S.W. Railway to purchase the Waterloo and City Railway, some of the permanent Parliamentary officials thought it would be more convenient and better for all purposes if it contained the terms upon which the transfer was to be made. This necessitated the present meeting, to consider the terms. The directors met 10 or 12 of the largest proprietors, and explained to them exactly how matters stood. The terms proposed were that every £100 of Waterloo and City ordinary stock should be exchanged for £67 of South-Western ordinary stock, or £105 of South-Western 3½ per cent. preference stock, or £110 of South-Western 3 per cent. debenture stock. The transfer should take place on January 1st next. Shareholders would receive their dividends on the earnings up to the end of December, and the dividends on the exchanged stock would commence on January 1st.

The resolution approving the terms was adopted.

Primitiva Gas and Electric Lighting Co. of Buenos Ayres.—The directors recommend a dividend of 7 per cent. per annum on the ordinary shares for the past year.

Canadian General Electric Co.—The report for 1905 shows a profit of $608,206. Four quarterly dividends at the rate of 10 per cent. per annum on the common stock, two half-yearly dividends at the rate of 6 per cent. per annum on the preferred stock, and interest upon advances from the company's bankers have been paid, these amounting in all to $461,487.

Eastern Extension, Australasia and China Telegraph Co.—The directors have declared a dividend for the quarter ended December 31st of 2s. 6d. per share, together with a bonus of 4s. per share, or 2 per cent., making a total distribution of 7 per cent. for the year 1905.

Anglo-American Telegraph Co.—The directors have resolved to declare an interim dividend for the quarter ending March 31st, 1906, of 15s. per cent. on the ordinary stock, and £1 10s. per cent. on the preferred stock, less income-tax, payable on May 1st.

Prospectuses.—*Manx Electric Railway Co.*—The subscription list was to close on Tuesday in an issue of £200,000 4½ per cent. irredeemable first mortgage debenture stock and 22,900 5½ per cent. cum. preference shares of £5 at par, which are offered for sale by Messrs. J. Henry Schröder & Co. The company was formed in 1902 to acquire the double-track electric railway, 22½ miles long, running from Douglas to Laxey and Ramsey, and from Laxey to Snaefell. It will be remembered that, consequent on the failure of Dumbell's Bank, to which it was indebted for advances made during construction, the original company went into the hands of a receiver.

Kepitigalla Rubber Estates, Ltd.—This company has been offering 200,000 £1 shares for subscription. Its object is to acquire various estates in Ceylon.

Straits Settlements (Bertam) Rubber Co.—This company has been offering 150,000 £1 shares for subscription. The company will acquire and develop rubber plantations on the Bertam Estate, in the province of Wellesley, Straits Settlements.

Greenock and Port Glasgow Tramways Co.—At the meeting held in London on 30th ult., Viscount Emlyn stated that the outlay on the electrical construction account during the year amounted to £2,343, making the total expenditure thereon to December 31st last £188,378. The total revenue for the year amounted to £34,229 and the expenditure to £25,562, which sum included interest, rentals payable to corporations, cost of repairs and maintenance, and a provision of £1,500 for depreciation and renewals, leaving a profit of £8,666. The directors recommended that there should be placed to reserve (sinking) fund, £1,770; dividend, 5 per cent. on preference shares, £3,500; dividend, 3 per cent. on ordinary shares, £3,450; balance carried forward, £277. The reserve (sinking) fund would then stand at £7,383 19s. 10d. With regard to the claim of the Greenock Corporation in respect to profits referred to in the last report, the Board of Trade having refused to state a case for decision on points of law, the High Court came to the conclusion, after hearing arguments, that it had no jurisdiction. Thereupon the Board of Trade issued its award on the lines of the recommendations of their inquirer, and the company was consequently bound to pay over the sum awarded. The report was adopted.

Rothesay Tramways Co.—The meeting of this company was held in London on 30th ult. Viscount Emlyn said that the total revenue for the year was £10,397, and the expenditure £8,820. There remained £1,614, which the directors recommended should be applied as follows: To depreciation and renewals account, £1,500; to carry forward £114. The report was adopted.

Windsor Electrical Installation Co.—The annual meeting of this company was held on 21st ult; Mr. H. L. Prior presided. He said that the revenue figures were practically a repetition of previous years. There was a profit of £4,600 as against £4,500 in 1904. They had sold many more units at a considerably lower price. They had decided to follow the example of other companies, and abandon the electrical installation part of the business, and to confine themselves to the legitimate work of a supply company. The loss on the year's trading in that department was £654. The dividend on the ordinary shares is 5 per cent. for the year. The report was adopted after a good deal of discussion.

Bromley Electric Light and Power Co.—This company's annual meeting was held on Monday last week, Mr. F. E. Gripper presiding. The profit on trading was £8,782, and the dividend on the ordinary shares was 5½ per cent. for the year, with £2,040 placed to reserve, leaving £48 to be carried forward. They had had additional competition from the gas companies both for lighting and power, but they were able to hold their own and make progress in spite of that. The revenue per lamp had fallen from 4s. to 3s. 10d. The capital expenditure for the year was almost entirely for the purpose of connecting new consumers, and making slight additions to the mains, &c. The machinery and plant were capable of doing all they wanted for a year or two to come, at any rate. They would not want more than £5,000 in the coming year for their extensions, and that they would obtain by an issue of 1,000 ordinary shares of £5. The report was adopted.

Babcock & Wilcox.—The report for 1905 states that the net profit during the year, after deducting depreciation, &c., amounts to £291,022, plus the balance brought forward from last account, £28,519. The directors recommend a dividend of 8 per cent. on the ordinary shares and a bonus of 4 per cent. on the ordinary shares, making 20 per cent. for the year, placing to reserve fund £100,000 and to dividend equalisation fund £20,000, leaving a balance to be carried forward of £31,966.

Bell's Asbestos Co.—A dividend of 12½ per cent. for 1905 is recommended, with a carry forward of £6,578. The dividend for 1904 was at the rate of 6 per cent.

Harrow Electric Light and Power Co.—At the annual meeting held on 29th ult., Mr. J. N. Stuart moved the adoption of the report for 1905, which showed an increase in the output by 25,724 units. The receipts were £7,789, as against £7,600, and the working expenses showed a favourable decrease. A 5 per cent. dividend on the ordinary shares was recommended. It is proposed to issue £6,325, the balance of the ordinary shares. The cost of coal per unit was now 0·67d. Mr. G. W. Spencer Hawes seconded the motion, and it was adopted. Mr. Hawes said that the condenser had reduced the coal bill by 16 per cent.

Guildford Electricity Supply Co.—Dr. F. R. Russell presided at this company's annual meeting on the 27th ult. He moved the adoption of the report for 1905, which showed that the gross receipts were £5,374, as compared to £4,860 for 1904. There was a balance on revenue account of £1,683, after writing off £500 for depreciation, £200 for preliminary expenses and £150 for a further instalment on the suspense account for law costs. After paying preference share and debenture interest, £58 remained to be carried forward. During the year a new boiler and engine and dynamo were installed to meet increasing business. The chairman said that they had not thought it wise to pay an ordinary dividend, because they wanted to get rid of the large amount on the suspense account and the preliminary expenses. The total capital outlay of the year was £6,217. The cost of coal was 1·2d. per unit. The report was adopted.

Swansea Improvements and Tramways Co.—The annual meeting was held at Donington House on 6th inst. Mr. C. G. Tegetmeier, the chairman, said there was a net profit on the tramways undertaking of £4,749. It was not to be expected that the extensions would immediately reach their full earning capacity. The payment to be made to the Swansea Corporation had not yet been settled. The new lines would have to be developed before an adjustment could be made. Under the circumstances it was satisfactory to have made the profit they had. The total amount paid for local taxation on the two undertakings was £3,991, more than 6 per cent. of the total gross earnings of the two undertakings. Mr. W. G. Bond seconded. The report was adopted.

Indo-European Telegraph Co.—The directors recommend a dividend for the six months ending December 31st, 1905, of 17s. 6d. per share (making, with the interim dividend already paid, 6 per cent. for the year), and a bonus of 20s. per share, both free of income-tax. There is also recommended a special distribution of 15s. per share, free of income-tax, out of interest accrued during the year upon investments. The dividend, bonus and special distribution as above will be payable on and after May 1st. The transfer books will be closed from April 11th to 24th.

Woking Electric Supply Co.—Mr. John Ashby presided on Tuesday last week at the annual meeting of this company. In moving the adoption of the report (see Electrical Review, March 30th), he said that the revenue account showed an increase of £1,135. Between 1900 and 1905 the revenue had very nearly trebled itself. The coal cost had only increased by £100, largely due to new and improved machinery. From January 1st to the present time they had had the advantage of using all their new machinery, and during these three months they had generated nearly 11 per cent. more electricity than at the same period last year, and the coal cost actually showed a decrease of 25 per cent. (or £180). The directors were prepared to issue the balance of the ordinary shares to meet the cost of extensions. Their assessment had been unfairly increased, and they were going to appeal against it. The report was adopted.

Milford-on-Sea Electric Supply Co.—The annual meeting was held on March 30th, Dr. V. D. Harris presiding. The chairman said there was nothing to complain of, with one exception—the storage batteries; they had been somewhat unsatisfactory, not maintaining their normal capacity. The directors had the matter under consideration, and were contemplating entering into an agreement with the makers by which they would guarantee that the storage should be maintained at a certain definite point. The report was adopted. A dividend of 3 per cent. was declared, £40 placed to the depreciation fund, £20 written off the preliminary expenses account, and a balance of £8 carried forward.

Folkestone Electric Light Co.—The report to December, 1905, states that the equivalent of 76,937 8-c.p. lamps were being supplied. There is a profit on the revenue accounts of £9,801, which, with the profits on the installation work, &c., and the sum of £309 brought forward, and after allowing for interest on debenture stock, dividend on preference shares and bank charges, &c., and carrying the sum of £1,500 to the depreciation fund, there is a net balance for distribution, after allowing for the 4 per cent. interim dividend already paid, of £1,916. The directors recommend a dividend at the rate of 7 per cent, less income-tax, for the half-year (making 5½ per cent. for the year), leaving a balance of £161 to carry forward. There is a very large increase under the head of rates and taxes. Notice of appeal has been given by the company against the assessments. A further issue of £25,000 4½ per cent. first debenture stock has been made during the year at 2 per cent. premium. The amount of premium, less the expenses on the issue, has been credited to a debenture premium reserve fund. It is proposed shortly to make a further issue of 4½ per cent. debenture stock to rank with the £75,000 first debenture stock already issued.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Fortnight ended.	Receipts for the fortnight. £	Receipts for the fortnight. £*	No. of wks.	Total to date. £	Total to date. £*	Route miles open.	*
†Aberdeen	Mar. 31	1,151	+ 8	44	58,975	— 726	14·4	..
Ayr	,, 31	377	— 12	45	12,308	— 83	8	..
Bath	Apr. 4	295	+ 108	14	8,915	+ 1,220	13	..
Belfast	,, 6	1,947	+1,420	14	40,815	+ 9,528	40	+ 6½
†Birkenhead	,, 1	5,995	— 29	52	..	..	13·5	..
Blackburn	,, 4	..	..	1½	1,249	+ 58	13·75	..
Blackpool Corp.	Mar. 31	..	..	52	49,780	+ 1,984	11·87	..
† ,, —Fleetw'd	,, 31	229	— 41	13	2,470	— 75	8·25	..
† ,, —Lytham	,, 29	166	— 25	21	3,225	+ 243	7½	..
†Bolton	Apr. 1	1,918	+ 56	1	1,918	+ 572	26	+ 1
Bournemouth	Mar. 31	1,887	+ 577	52	73,064	+17,411	17·4	+ 7½
†Bradford	,, 31	4,051	+ 65	52	224,147	— 1,760	53	..
Brighton	,, 25	1,367	— 327	52	49,520	..	9·5	..
Bristol	Apr. 6	9,431	+ 311	..	..	..	28·5	..
Brit. Elec. Trac. Co								
Airdrie	Mar. 30	437	+ 64	13	2,756	+ 279	3·65	..
Barrow	,, 30	429	+ 6	,,	2,585	+ 198	5·37	..
‡Birmingham (City)	,, 30	10,283	—1,450	,,	65,856	— 2,920	14·5	..
Birmingham (Mid.)	,, 30	2,861	— 865	,,	17,380	— 4,589	12·25	..
Devonport	,, 30	771	— 123	,,	5,103	— 345	8·85	..
Dudley—Sto'rb'ge	,, 30	1,514	— 126	,,	9,512	+ 223	21·25	..
Gateshead	,, 30	1,794	+ 35	,,	11,617	+ 559	11·25	..
Gravesend, N'fleet	,, 30	389	— 23	,,	2,487	+ 83	6·5	..
Greenock	,, 30	1,200	+ 53	,,	7,243	+ 534	7·25	..
Hartlepool	,, 30	499	— 13	,,	3,200	+ 112	6·72	..
Leamington	,, 30	249	+ 127	,,	1,653	+ 591	3	..
Merthyr	,, 30	360	— 14	,,	2,228	— 25	2·9	..
‡Metropolitan	,, 30	5,599	+1,019	,,	35,176	+10,562	22	..
Middleton	,, 30	585	— 37	,,	3,568	+ 199	8·5	..
Oldham — Ashton	,, 30	1,040	— 27	,,	6,470	+ 226	9·13	..
Peterborough	,, 30	196	— 51	,,	1,226	— 98	5·31	..
Potteries	,, 30	3,472	+ 4	,,	22,084	+ 1,206	29	..
Rothesay	,, 30	112	+ 9	,,	6·8	+ 46	2·75	..
Southport	,, 30	475	— 54	,,	2,942	— 26	8·17	..
South Staffs.	,, 30	1,523	+ 123	,,	9,748	+ 1,486	13·87	..
Swansea	,, 30	1,450	+ 474	,,	9,074	+ 3,147	5·5	..
Tynemouth	,, 30	326	— 56	,,	2,039	— 152	3·75	..
Weston-s-Mare	,, 28	63	— 17	,,	350	— 13	3	..
Wolverhampton D.	,, 30	755	+ 22	,,	4,756	+ 388	14·75	..
‡Worcester	,, 30	452	+ 119	,,	2,954	— 902	5·75	..
Yorks. Wool. Dist.	,, 30	1,640	+ 3·7	,,	10,318	+ 3,294	17	..
Miscellaneous	,, 30	3,527	— 50	,,	22,386	— 74	..	..
†Burnley	Mar. 31	1,032	— 67	..	..	..	7·5	..
†Burton-on-Trent	,, 31	252	— 53	52	15,680	..	8·5	..
†Bury	,, 25	815	..	51	39,120	..	10·5	..
Cardiff	,, 31	3,566	+ 165	52	104,724	+ 514	15·87	..
†Carlisle	,, 31	149	— 2	13	2,022	+ 157	..	..
†Chatham and Dist.	,, 29	538	— 62	13	7,235	— 191	9·3	+ 8
Colchester	,, 7	327	— 5	31	5,660	..	7⅞	+ ⅛
Cork	Apr. 5	820	— 59	14	5,654	— 42	9·89	..
†Darlington	Mar. 31	178	— 1	52	10,478	..	4·87	..
†Darwen	,, 30	210	— 17	52	12,498	+ 750	4·36	..
†Dover	,, 31	172	+ 3	52	11,323	+ 146	4·75	+ 1½
†Dublin	,, 30	4,120	— 257	13	57,588	+ 1,343	48·5	+ ·5
Dundee	Apr. 4	1,915	+ 293	46	43,358	+ 4,169	12·5	..
†East Ham	Mar. 31	785	+ 41	52	42,816	+ 5,915	8	+ ½
Exeter	,, 23	443	..	51	13,989	..	4·25	..
†Glasgow	,, 31	15,647	+ 965	43	669,594	+43,996	78	+ 4·5
†Gloucester	Feb. 21	221	+ 12	..	..	..	15	..
†Halifax	Mar. 28	1,233	— 41	52	79,747	+ 5,968	37	+ 1·5
Hastings	Apr. 5	764	..	..	..	..	..	..
Huddersfield	Mar. 24	2,590	+ 146	51	69,325	+ 4,131	28	..
†Hull	,, 31	2,068	— 143	52	115,538	+ 2,610	13	..
†Ilford	,, 31	402	— 26	52	23,906	+ 1,128	6·37	..
†Ilkeston	,, 28	106	— 10	52	6,089	— 679	3·5	..
†Ipswich	,, 31	304	+ 6	52	21,352	— 1,984	10·5	..
†Isle of Thanet	,, 31	237	— 79	13	3,048	— 160	11	..
†Kilmarnock	,, 31	138	— 9	46	7,081	..	4·12	..
Kirkcaldy	Apr. 4	412	— 27	..	..	..	7·5	..
†Lan'kshire Trm.Co.	Mar. 29	794	+ 186	13	10,523	+ 2,373	12·5	+ 3·9
Leeds	,, 31	11,031	— 92	52	309,133	+ 9,599	89·5	+ 8
†Leicester	,, 31	1,984	+ 20	13	25,923	+ 2,957	..	..
Leith	,, 31	849	+ 419	45	16,989	..	6	+ 1
†Liverpool	,, 24	10,415	+ 115	12	121,795	+ 4,564	104	+ 1
L.C.C.	,, 24	28,084	+1,359	51	744,740	+94,527	51	+ 5·6
†London United	Apr. 6	5,810	+ 466	14	66,839	+ 1,340	41	..
†Lowestoft	Mar. 31	106	— 14	27	3,458	— 87	3·5	..
†Manchester	,, 31	12,174	+ 251	52	665,334	+33,603	84	..
Nelson	..	..	..	..	..	..	..	..
†Newcastle	,, 31	3,608	— 27	52	197,167	+ 4,566	25·5	..
Newport	,, 31	1,046	— 20	26	14,162	+ 989	14·5	+ 1·5
Northampton	,, 23	718	— 41	51	21,351	+ 5,276	5·5	..
Oldham	,, 24	3,001	+ 503	52	84,148	+18,595	23·75	+ 1·6
†Pontypridd	,, 31	165	..	52	8,196	..	3·5	..
†Portsmouth	,, 31	1,391	— 235	52	97,229	+ 1,529	14·5	..
Preston	Apr. 4	1,255	+ 123	..	..	..	10	..
Reading	Feb. 22	1,072	+ 18	47	29,267	— 498	7·5	..
†Rochdale	Mar. 31	817	+ 344	52	40,825	+26,129	21·2	+ 5·8
†Rotherham	,, 29	398	— 3	52	23,498	+ 28	9·3	..
†Salford	,, 31	3,095	+ 970	52	222,873	+13,459	38·9	..
†Sheffield	Apr. 1	4,868	+ 185	1	4,868	— 247	35·75	-1·5
†Southampton	Mar. 28	756	— 87	25	21,832	+ 46	..	..
†Southend-on-Sea	,, 28	224	— 33	52	18,391	+ 1,063	6	..
Stalyb'dge, Hyde, &c.	,, 31	1,184	+ 126	52	32,745	..	21	..
Stockport	,, 30	1,575	+ 548	52	39,645	+11,850	15·5	+ 4
†Sunderland	,, 31	1,081	+ 339	52	67,795	+ 3,528	10·87	..
Swindon	Apr. 4	339	— 30	52	10,005	..	4·4	..
Tyneside	Mar. 28	721	— 19	13	4,348	+ 97	8·87	..
Warrington	,, 29	677	+ 43	52	17,804	+ 1,247	6·37	+ ·25
†West Ham	,, 29	1,816	+ 648	52	96,008	+41,144	14·7	+ 4·9
Wolverhampton	Apr. 4	1,425	..	..	..	..	10	..
†Yorks. W. Riding	,, 1	762	+ 171	13	8,882	..	..	..
Baker St.-Waterloo	Mar. 31	3,136	..	3	4,899	..	3·25	..
†Cen. London Rly.	,, 31	6,905	— 149	13	90,546	— 2,661	6	..
City & S. Lon. Rly.	Apr. 8	5,787	+ 236	14	41,617	+ 436	6·25	..
Dublin-Lucan Rly.	,, 6	189	— 16	14	1,247	— 90	7	..
†G. N. and City Rly	Mar. 31	1,831	+ 109	13	23,690	+ 840	3·5	..
†L'pool Overh'd Rly.	Apr. 1	1,352	— 137	13	17,972	— 1,180	6·65	..
†Mersey Railway	Mar. 31	1,762	+ 190	13	22,089	+ 1,149	4·5	..
†Metropolitan Rly.	Apr. 1	16,756	— 257	13	221,201	— 2,951	70·5	..
†Met. District Rly.	,, 1	7,889	+ 413	13	105,350	+ 5,754	24	..
†Anglo-Argentine	,, 1	15,311	+1,599	13	193,580	+20,135	43	..
§Auckland	Mar. 30	9,584	+ 482	13	31,292	+ 1,310	18·64	..
§Brisbane	,,	11,511	+1,569	..	..	..	..	..
†Bu'n's A'r's E.T. Co.	,, 10	2,981	+ 756	10	14,225	+ 3,434	24	..
Bu'n's A'r's-Blgr'no	Apr. 1	7,185	+ 549	13	45,953	+ 4,004	..	..
Calcutta	,, 7	6,821	+ 550	..	..	..	..	..
§Cape Electric T. Ld.	Feb.	15,306	..	..	..	..	..	..
§Geneva	,,	6,231	+ 255	..	..	..	..	..
†Perth (W.A.)	Mar. 30	1,504	+ 118	13	19,914	+ 1,022	24·25	+ 5½

* Compared with the corresponding period of 1905. † One week only.
‡ Includes horse, steam and other receipts. § One month.

STOCKS AND SHARES.

Monday Evening.

When imperious Editors combine with Easter holidays, the result to the unfortunate scribe is apt to be a trifle hurried. But we cannot complain as much as a market which lies at the mercy of possible municipal competition, as the electric lighting section now does. Business is in the same state of suspended animation as it was when we last wrote, and there is a tendency on the part of monied men to cut their English Industrials in order to place the capital in foreign securities.

While Babcock & Wilcox can go on piling-up profits at the rate shown by the report just out, Mr. Chamberlain will have no cause to complain that their industry is "going." The dividend and bonus are again made up to 20 per cent. for the full year, and the price of the shares remains at 4. London Electric Supply shares are steady at 2¼, a few buyers coming in upon news that the company had secured a contract for supplying the Brighton Railway with electric power.

The Electric List is very quiet, but Charing Cross and City Preference hardened after their drop, although the parent shares continue dull. We understand that the Bournemouth and Poole new issue will not appear until after Easter. The new Anglo-Argentine Tramway shares may come any day, and there are two more motor-omnibus prospectuses ready for the public. This flood of motor undertakings is one of the minor causes making for weakness in British Electric Tractions. The fall in these shares has sent a shoal of daily inquiries into the market, where the reasons advanced for the decline are those which have been thoroughly discussed in these columns.

Depreciation being one of the most vital points of an electric lighting company's finance, too much attention can hardly be given to the proportion written off, out of revenue, in the various Metropolitan cases. Taking the average capital employed during the year ended last December 31st, the amounts per cent. applied to depreciation and written off out of revenue may be summarised as follows:—

Company.	Per cent.	Company.	Per cent.
Brompton	$3\frac{1}{10}$	Metropolitan	1¼
Charing Cross	$1\frac{1}{10}$	Notting Hill	$1\frac{3}{10}$
Chelsea	2¾	St. James'	2½
City of London	2¼	South London	$3\frac{3}{10}$
County of London ...	⅞	South Metropolitan ...	1
Kensington	1½	Smithfield	2
London	2⅓	Westminster	3

Nothing is allowed in these figures for such extraneous sources of income as premiums on share issues. The calculations are worked out, as stated above, upon the average amount of capital employed during the year.

To hark back for a moment to new issues, it is understood that the recent Lancashire Tramways had anything but a warm reception at the hands of the public.

Railway descriptions are, as usual, featureless. Metropolitan slipped back to 77½, but the Tube Stocks display no change on the week. In spite of the reduction in the Bank Rate and of the distribution of the quarterly dividends upon Consols and their satellites, investment business is inclined to hang fire. The electric lines are somewhat suspect by reason of the rapid growth in competition of all kinds. Even the steamboats on the Seine are suffering from a similar cause, and the company's report for last year tells of a substantial decline in receipts.

Several dividend announcements have failed to galvanise the telegraph department into animation. The Eastern Extension makes up its annual rate to 7 per cent., and the Cuba Submarine declares a dividend at the rate of 5 per cent. Neither quotation has altered. Submarine Cables Trust certificates are a shade better, but Globes have not changed. With the coming of the holidays there is the usual disposition to restrain from either buying or selling, and markets all round are very passive.

Madras Electric Tramways (1904).—The report for 1905 states that the net profit, after providing for maintenance, interest on debenture stock, &c., and £1,500 to depreciation and renewal fund, is £1,119. The directors recommend the dividend of 2½ per cent. per annum distributed in July last, which would absorb £887, and leave £231 to be carried forward. The traffic has been adversely affected by the severe famine during 1905, and the consequent depression in Madras. Under the favourable conditions that have prevailed since the beginning of 1906, the receipts show substantial improvement. The extensions are under construction, and will be in operation before the end of July.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last four years. 1902.	1903.	1904.	1905.	Closing Quotations April 4th.	Closing Quotations April 9th.	Business done week ended April 9th, 1906. Highest	Lowest.	Rise + or Fall —
17,700	African Direct Telegraph, 4 % Debs...	100	4 %	4 %	4 %	4 %	98½—101½	98½—101½	..	..	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	..	3¾ — 4¼	3¾ — 4¼	..	..	..
155,600£	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	Nil	Nil	Nil	5 %	83 — 88	83 — 88	..	..	..
702,600	Anglo-American Telegraph	Stock	60/6	61s.	23/0	31/0	65 — 67	65 — 67	..	..	..
3,148,700	Do. do. do. 6 % Pref.	Stock	6 %	6 %	5½ %	6 %	112½—113½	112½—113½	113¾	112½	..
3,148,700	Do. do. do. Deferred	Stock	1/-	2s.	Nil	1/0	19⅞— 20⅝	19⅝— 19⅞	20	19½	— ¼
50,000	Anglo-Portuguese Tel., 5% Mort. Deb. Stock Red.	100	..	..	..	..	101 —103	101 —103	103	102½	..
44,000	Chili Telephone, Nos. 1 to 44,000	5	6 %	7 %	8 %	..	8 — 8¼	8 — 8¼	..	..	..
1,982,856£	Commercial Cable Stlng. 500 year 4 % Deb. Sk. Red.	Stock	4 %	4 %	4 %	4 %	96½— 98½	97 — 99 xd	..	..	..
16,000	Cuba Telegraph	10	6¼%	10 %	5 %	5 %	8¾— 9	8¾— 9	..	..	..
6,000	Do. 10 % Pref.	10	10 %	5 %	10 %	10 %	17 — 18	17 — 18	..	..	..
12,981	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	4 %	3⅜— 3⅝	3⅜— 3⅝	..	..	..
6,000	Do. do. 10 % Cum. Pref. ..	5	10 %	10 %	10 %	10 %	8½— 9	8½— 9	..	..	..
80,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%	100 —103 %	100—103	..	..	..
60,710£	Direct United States Cable	20	8½%	8 %	8½%	8⅝%	15½— 15⅞	15½— 15⅞ xd	15⅝	15⅜	..
70,000	Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,200,R.	100	4½%	4½%	4½%	4½%	100 —102	100 —102	..	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	7 %	146 —149	145 —148	147½	147¼	—1
2,000,000	Do. 8½ % Pref. Stock	100	8½%	8½%	8½%	8½%	90 — 92	90 — 92	90⅝	..	..
1,848,772	Do. 4 % Mort. Deb. Stock Red. ..	Stock	4 %	4 %	4 %	4 %§	107 —109	107 —109	..	..	..
300,000	Eastern Extension, Australiasia, and China Tele.	10	7 %	7 %	7 %	6 %§	14⅜— 15¼	14⅜— 15¼	15⅛	14⅜	..
752,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %§	105 —107	105 —107	106⅜	..	..
300,000	East & S. Afric. Tel., 4 % Mt. Db., 1 to 3,000, red. 1909	100	4 %	4 %	4 %	4 %	99 —101	99 —101	..	..	..
200,000£	Do. 4 % Reg. M. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	4 %	101 —103 %	101 —103	..	..	..
180,887	Globe Telegraph and Trust	10	£3	5½%	5⅜%	5 %	10⅞— 11⅛	10⅞— 11⅛	11⅛	10⅝	..
180,887	Do. do. 6 % Pref.	10	6 %	6 %	6 %	6 %	14⅜— 14⅝	14⅜— 14⅝	14⅝	14⅜	..
150,000	Great Northern Telegraph, of Copenhagen ..	10	12½%	15 %	24 %	24%	39½ — 41½	39½ — 41½	40⅝	..	..
42,300	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	4½%	4½%	4½%	4½%	100 —102	100 —102	..	..	..
17,000	Indo-European Telegraph	25	10 %	10 %	13 %	5 %	57 — 59	57 — 59	58½	..	..
251,127	Marconi's Wireless Telegraph	1	..	..	..	..	1⅛— 1⅜	1⅛— 1⅜	25/-	..	..
72,680	Monte Video Telephone Co., Ltd. Ord.	1	3 %	3 %	4 %	..	1/2— 1 1/16	1/2— 1 1/16	..	..	..
86,492	Do. do. do. 5 % Pref. ..	1	5 %	5 %	5 %	..	7/8— 1	7/8— 1	..	..	..
1,983,333	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	109 —111	109 —111	110⅜	109½	..
1,966,667	Do. do. Def. Stock	100	4½%	5 %	5 %	5 %	111 —113	111 —113	111⅝	111½	..
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	6 %	12 — 14	12 — 14	13½	13	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	6 %	10½ — 12½	10½ — 12½	11½	11½	..
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %	5¼— 5½	5¼— 5½	5 1/16	..	..
2,000,000	Do. do. 3½ % Deb. Stock Red. ..	Stock	3½%	3½%	3½%	3½%	99 —101	99 —101	..	..	..
1,689,598	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	103 —105	103 —105	104½	103⅜	..
179,318	Oriental Telep. and Elec. 1 to 171,504, fully paid	1	6 %	6½%	6½%	7⅜%	1⅛— 1⅜	1 1/16— 1 7/16	27/9	26/6	+ 1/16
50,000	Do. do. do. 6 % Cum. Pref. ..	1	6 %	6 %	6 %	6 %	1¼— 1⅜	1¼— 1⅜	25/6	..	..
100,000	Do. do. do. 4% Red. Deb. Stock	100	..	..	..	4 %	98 —100	98 —100	..	..	..
100,000	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	4 %	4 %	4 %	99 —102	99 —102	..	..	..
11,839£	Reuter's	8	5 %	5 %	5 %	5 %§	7½— 7¾	7½— 7¾	..	..	..
60,000	Telephone Co. of Egypt, 4½ % Deb. Red.	100	..	..	..	4½%	103 —106	103 —106	..	..	..
3,201	Submarine Cables Trust	Cert.	6 %	6 %	6 %	6 %	128 —131	129 —132	130	..	+ 1
70,000	United River Plate Telephone	5	7 %	8 %	8 %	..	7 — 7½	7½— 7⅝	7 1/16	7⅛	..
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	5 %	5½— 5¾	5¾— 5¾	..	..	..
179,947	Do. do. 5 % Debs.	Stock	5 %	5 %	5 %	5 %	110 —112	110 —112	111	..	..
15,609£	West African Telegraph, Shares	10	2 %	4 %	4½%	4 %	9⅞— 10½	9⅞— 10½	..	..	..
80,008	W. Coast of America, 1 to 80,000 & 53,001 to 53,008	2½	Nil	Nil	Nil	..	3/8— 1/2	3/8— 1/2	..	..	..
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4 %	4 %	4 %	4 %	100 —102	100 —102	..	..	..
207,980	Western Telegraph, Ltd., Nos. 1 to 207,980 ..	10	7 %	7 %	7 %	5 %	14½— 14⅝	14 — 14½ xd	14½	14⅛	..
75,000	Do. do. 5 % Debs. 2nd series, 1906	100	5 %	5 %	5 %	5 %	100 —102	100 —102	..	..	..
563,380	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	102 —104	100½—102½	..	..	—1½
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	..	3/8— 1/2	3/8— 1/2	..	..	..
84,563	Do. do. 6 % Cum. 1st Pref.	10	7 %	7 %	6 %	6 %	8¼— 8½	8¼— 8½	8¼	..	..
4,669	Do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	Nil	..	6 — 7	6 — 7	..	..	..
80,000£	Do. do. 5 % Debs., Nos. 1 to 1,800 ..	100	5 %	5 %	5 %	5 %	101 —104	101 —104	..	..	..

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

170,000	Anglo-Argentine Trams, 260,008 to 430,007	5	..	..	8 %	8 %	9 — 9¼	9 — 9¼	9⅛	..	..
260,007	Do. 5½ % Cum. Prefs., 1 to 260,007 ..	5	..	5 %	5 %	5½%	5⅝— 6⅛	5⅝— 6⅛	6 1/16	6⅛	..
266,600	Do. Permanent, 6 % Deb. Stock, 1888	100	..	6 %	6 %	6 %	141 —144	141 —144	144	..	..
285,100	Auckland E. Trams., 5 % 1st Mort. Deb. Stock ..	100	..	5 %	5 %	5 %	104 —106	104 —106	106	..	..
800,000	Babcock & Wilcox, 1 to 530,000	1	..	17 %	20 %	20 %	3⅞— 4⅛	3⅞— 4⅛	80/7½	78/9	..
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	..	6 %	6 %	6 %	1 7/16— 1 9/16	1 7/16— 1 9/16	..	..	..
38,000	British Aluminium, Ord., 2,001 to 40,000 ..	5	..	..	..	..	2 3/16— 2 5/16	2 3/16— 2 5/16	..	..	..
40,000	Do. do. 7 % Cum. Pref...	5	Nil	Nil	Nil	3/6	6¼— 6⅝	6¼— 6⅝	..	..	..
20,000	Do. do. "A" 6 % Cum. Pref.	5	Nil	Nil	Nil	3/-	5¼— 5⅝	5¼— 5⅝	..	..	..
20,000	Do. do. 4 % Funding Certs.	5	..	..	..	..	2⅞— 3⅛	3 — 3⅛	..	..	+ ⅛
800,000£	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	5 %	5 %	5 %	5 %	100 —104	101 —105	..	..	+ 1
300,000	British Columbia E. Rail Def. Ord. Stock	100	..	6 %	6 %	..	120 —123	120 —123	..	..	..
300,000	Do. 5 % Pref. Ord. Stock	100	..	5 %	5 %	..	110 —113	110 —113	108	..	..
115,000	Do. 5 % Cum. Perp. Pref. Stock	100	..	5 %	5 %	5 %	107 —110	107 —110	..	..	..
240,400	Do. 4½ % 1st Mort. Debs., 1 to 6,250	40	..	4½%	4½%	4½%	103 —105 %	103 —105%	..	..	..
220,000	Do. 4½ % Vancouver Power Debs., 1 to 2,200	100	..	4½%	4½%	4½%	102 —105	102 —105	..	..	..
133,301	British Electric Traction	10	8 %	6 %	6 %	..	6 — 7	6 — 7	6½	6⅜	..
161,487	Do. do. 6 % Cum. Pref.	10	6 %	6 %	6 %	6 %§	9 — 9¼	9 — 9¼	9⅜	9⅞	..
1,415,422£	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	5 %	111½—114½	111 —114	112⅜	112	— ½
410,178	Do. do. 4½ % 2nd Deb. Stock Red.	100	..	..	4½%	4½%	97 — 99	97 — 99	112	111½	..
100,000	British Insulated and Helsby Cables	5	10 %	8 %	8 %	8 %	6¾— 7	6¾— 7	..	..	..
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	5⅞— 6¼	5⅞— 6¼	..	..	..
500,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	4½%	4½%	4½%	4½%	103 —106	103 —106	..	..	..
212,000	British Thomson-Houston 4½ % 1st Mort. Debs. ..	100	..	4½%	4½%	4½%	96 — 98	96 — 98	..	..	..
400,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 475,000	5	..	6 %	Nil	..	1⅞— 2⅛	1⅞— 2⅛	..	..	..
1,016,353	Do. do. 4 % Mort. Deb. Stock ..	100	..	4 %	4 %	4 %	80 — 85	80 — 85	..	..	..
50,000	¶Browett, Lindley & Co., Ord.	£1	Nil	Nil	Nil	..	9/16— 11/16	9/16— 11/16	..	..	..
50,000	¶ Do. do. 6 % Cum. Pref. ..	£1	Nil	Nil	Nil	..	14/6 to 15/6	14/6 to 15/6	..	..	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731 ..	2	Nil	Nil	Nil	2½%	3/4— 1	3/4— 1	..	..	..
150,000	Do. Non-cum. 6 % Pref... ..	2	6 %	6 %	6 %	6 %	1¾— 2	1¾— 2	..	..	..
125,000£	Do. 4½ % Perp. Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	97 — 99	97 — 99	97½	..	..
125,000£	Do. 4½ % Perp. 2nd Deb. Stock	Stock	4½%	4½%	4½%	4½%	82 — 84	82 — 84	..	..	..
100,000	Buenos Ayres & Belgrano, 1 to 100,000	5	..	3 %	4 %	3 %	3⅜— 3⅝	3⅜— 3⅝	..	..	+ ⅛
40,000	Do. "A" 6 % Cum. Pref., 1 to 40,000	5	..	6 %	6 %	6 %	5⅞— 6¼	5⅞— 6¼	..	..	..
27,500	Do "B" do. 1 to 27,500	5	..	6 %	6 %	6 %	5¼— 5⅝	5¼— 5⅝	5⅝	..	..
317,700	Do. 5 % Deb. Stock	100	..	5 %	5 %	5 %	106 —108	106 —108	..	..	..
190,000	Do. 5 % 2nd Deb. Stock	100	..	5 %	5 %	5 %	102 —105	102 —105	..	..	..
105,000	Calcutta Trams., 1 to 105,000	5	..	6 %	8 %	8 %	9⅛— 9⅜	9⅛— 9⅜	9 3/16	9 7/16	..
32,610	Do. 105,001 to 137,610	5	..	..	..	8 %	9 — 9½	9 — 9½	9	..	..
350,000	Do. 4½ % 1st Deb. Stock	100	..	4½%	4½%	4½%	106 —108	106 —108	107⅜	107¼	..
35,000	Callender's Cable Construction shares	5	15 %	12½%	12½%	10%	10½— 11½	10½— 11½	10⅝	..	..
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	5½— 6	5½— 6	..	..	..
300,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	108½—110½	108½—110½	110⅛	109	..
491,222	Cape E. Trams., 1 to 491,222	1	..	15 %	10 %	5 %§	3/8— 7/16	3/8— 7/16	..	..	..
450,000	Castner-Kellner Alkali, 1 to 450,000	1	..	4 %	4 %	..	1 — 1¼	1 — 1¼	..	..	..
230,211	Do. do. 4½ % 1st Mort. Deb. Stock	100	..	4½%	4½%	4½%	95 —100	95 —100	..	..	..
1,939,698	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	4 %	91 — 93	91 — 93	91½	..	..
530,316	Do. do. 4 % Pref. Stock ..	Stock	4 %	4 %	4 %	4 %	101 —103	100 —102	..	..	1
530,316	Do. do. Def. do.	Stock	4 %	4 %	4 %	4 %	82 — 85	82 — 85	83½	82½	..
1,480,000	City and South London Railway	Stock	3½%	2⅞%	2½%	1 7/8%	41 — 43	41 — 43	43	42¼	..
85,000	Crompton & Co., Nos. 1 to 85,000	8	5 %	2½%	2½%	..	2 — 2¼	2 — 2¼	..	..	..
100,000£	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	..	5 %	5 %	5 %	5 %	95 — 98 %	95 — 98	..	..	..

period of nine months. ‡ Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. § Interim dividends. || And bonus of 10s. ¶ From Manchester Share List.

(Continued on next page.)

SHARE LIST OF ELECTRICAL COMPANIES.—*(Continued).*

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—*(continued).*

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years. 1902.	1903.	1904.	1905.	Closing Quotations April 4th.	Closing Quotations April 9th.	Business done week ended April 9th, 1906. Highest	Lowest.	Rise + or Fall−
52,000	Dick, Kerr & Co., 1 to 52,000	† £5	..	..	10 %	..	8⅜ — 9½	8⅜ — 9½	..	..	..
61,000	Do. do. 6 % Cum. Pref., 1 to 61,000	£5	..	6 %	6 %	6 %	6 — 6¼	6 — 6¼	6⅛	..	..
294,150	Do. do. 4½ % Deb. Stock	100	..	4½ %	4½ %	4½ %	104 —106	104 —106	..	..	..
60,000	Dublin United Trams. (1896), 1 to 60,000	10	..	5½ %	6 %	6 %	13⅜ — 14⅜	13⅜ — 14⅜	..	..	..
59,987	Do. 6 % Pref. between 1 and 60,000	10	..	6 %	6 %	6 %	14⅜ — 15½	14⅜ — 15½	..	..	..
63,400	Do. 4 % Debs.	100	..	4 %	4 %	4 %	99½ —100½	99½ —100½	..	..	..
300,000	Do. 3½ % "A" Debs.	100	..	3½ %	3½ %	3½ %	100 —100½	98 — 98½xd	..	..	..
300,000	Do. 3½ % "B" Deb. Stock	100	..	3½ %	3½ %	3½ %	97 — 97½	97 — 97½	..	..	..
99,261	Edison & Swan Utd., "A" shrs., £3 pd., 1 to 99,261	£5	Nil	Nil	2½ %§	..	1⅜ — 1⅝	1⅜ — 1⅝	..	..	..
17,189	Do. "A" shares, 01—017,189	£5	Nil	Nil	2½ %§	..	2½ — 3	2½ — 3	..	..	..
344,023£	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	86 — 88	86 — 88	..	..	..
100,000£	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	90 — 95	90 — 95	..	..	..
112,100	Electric Construction 1 to 112,100	£2	6 %	4 %	Nil	..	1/16 — 1/8	1/16 — 1/8	..	..	..
31,390	Do. do. 7 % Cum. Pref., 1 to 31,890	£2	7 %	7 %	7 %	..	2 — 2¼	2 — 2¼	..	..	..
200,000	Do. do. 4 % Perp. 1st Mort. Deb. Stk.	Stock	4 %	4 %	4 %	4 %	89 — 92	89 — 92	..	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	£10	5 %	5 %	5 %	..	9⅜ — 9⅝	9⅜ — 9⅝	..	..	..
200,000	Do. do. 4 % Mort. Deb.	Stock	4 %	4 %	4 %	4 %	92 — 96	92 — 96	..	..	..
78,000	Gt. N. & City Rail Pref. Ord. "A" 4 % 1 to 78,000	£10	..	3 %	4 %	4 %	4¼ — 4⅜	4¼ — 4¼	..	..	— ¼
96,000	Greenwood & Batley 7 % Cum. Pref.	£10	..	7 %	7 %	7 %	10¾ — 11¼	10¾ — 11¼	..	..	..
80,000	Do. do. 5 % Mort. Debs.	100	..	5 %	5 %	5 %	102 —104	102 —104	..	..	..
200,000	Henley's (W. T.), Telegraph Works, Ord.	£5	20 %	15 %	15 %	15%	12½ — 13½	12½ — 13½	..	..	..
200,000	Do. do. 4½ % Pref.	£5	4½%	4½%	4½%	4½%	5⅞ — 6⅛	5⅞ — 6⅛	5½	5 1/16	+ ⅛
41,978	Do. do. 4½ Mort. Deb. Stock	Stock	4½%	4½%	4½%	4½%	108 —110	108½—109½	..	..	..
108,022	Do. do. Scrip. £0 % paid	..	..	..	..	..	57 — 59	57⅞ — 59⅞	58⅛	57⅛	+ ⅛
50,000	India-Rubber, Gutta-Percha & Telegraph Works..	£10	10 %	10%	5 %	10%	17⅛ — 18⅛	17⅛ — 18⅛	18	17⅝	..
37,500	†Liverpool Overhead Railway, Ord.	£10	1⅛%	1⅛%	1⅛%	Nil	1⅜ — 1⅝	1⅜ — 1⅝	..	..	..
10,000	† Do. do. Pref. £10 paid	£10	5 %	5 %	5 %	5 %	6½ — 7	6½ — 7	..	..	..
600,070	London United Trams (1901), 1 to 50,007	£10	..	8 %	6 %	3 %	7 — 9	7 — 9	..	..	..
399,930	Do. do. 60,008 to 100,000 (£4 paid)	£10	..	8 %	6 %	3 %	2 — 3	2 — 3	..	..	..
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	£10	..	5 %	5 %	5 %	9½ — 10	9½ — 10	9⅛	..	..
1,331,000	Do. do. 4 % 1st Mort. Deb. Stock	£100	..	4 %	4 %	4 %	95 — 98	95 — 98	97⅜	..	..
314,016	Metropolitan Electric Trams, Defd.	£1	Nil	Nil	Nil	3 %	3/32 — 1/8	3/32 — 1/8	4/-	3/9	— 1/32
500,000	Do. 5 % Cum. Pref.	£1	5 %	5 %	5 %	5 %	1/16 — 1 1/16	1/16 — 1	19/6	18/3	— 1/16
350,000	Do. 4½ % Deb. Stock Red.	100	..	..	4½%	4½%	104 —106	104 —106	..	..	..
20,000	Peebles (B.) & Co. 6 % Cum. Pref., 20,001 to 40,000	£5	..	..	6 %	6 %	5 — 5¼	5⅛ — 5⅜	..	..	+ ⅛
24,500	Potteries E. Trc., 20,001 to 40 000 & 50,001 to 54,500	£10	..	5 %	5 %	4 %	8 — 9	8 — 9	..	..	..
24,500	Do. 5 % Cum. Pref., 1 to 20,000 & 40,001 to 44,500	£10	..	5 %	5 %	5 %	9 — 9½	9 — 9¼	..	..	..
245,000	Do. 4½ % Deb. Stock	100	..	4½%	4½%	4½%	103 —106	103 — 106	..	..	..
37,350	Telegraph Construction and Maintenance	£12	20 %	20 %	15 %	15 %	33 — 36	33 — 35	33¾	33½	— ½
150,000£	Do. 4 % Deb. Bds., 1 to 1,500 Red. 1909	100	4 %	4 %	4 %	4 %	100 —102	100 — 102	..	..	..
3,599,200	Undergd. E. R., Lon., 5 % Profit Shar. S. Nts.	..	..	..	5 %	5 %	98 —100	98 — 100	99½	98	..
540,000	Waterloo & City Railway, Ord. Stock	£100	3½%	3½%	3½%	3½%	101 —104	101 — 104	102½	..	..
66,666	Willans & Robinson, 1 to 30,000 & 80,001 to 116,666	£5	8⅓%	3 %	Nil	Nil	1⅜ — 2¼	1⅜ — 2¼	..	..	..
66,666	Do. 6 % C. P., 30,001 to 80,000 & 125,001 to 141,666	£5	..	6 %	Nil	Nil	3½ — 4¼	3½ — 4	..	..	..
246,806	Do. 4 % 1st Mort. Deb. Stock	£100	..	4 %	4 %	4 %	80 — 85	80 — 85	..	..	..

ELECTRICITY SUPPLY COMPANIES.

14,000	Bromley (Kent) E.L. & P., 1 to 14,000	£5	..	5 %	5½%	4 %§	5¼ — 5⅜	5¼ — 5⅜	5 1/16	..	..
50,000	Do. do. 4½ % 1st. deb. stock	£100	..	4½%	4½%	4½%	103 —106	103 —106	..	..	..
29,377	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	£5	8 %	10 %	10 %	10 %	8½ — 9½	8½ — 9½	..	..	..
10,623	Do. do. 7 % Cum. Pref.	£5	7 %	7 %	7 %	7 %	8½ — 9½	8½ — 9½	..	..	..
300,000	Central Electric Supply 4 % Guar. Deb. Stock	£100	4 %	4 %	4 %	4 %	102 —105	102 —105	104	102	..
80,000	Charing Cross and Strand Electricity Supply	£5	10 %	8 %	8 %	5 %	4¼ — 5¼	4 — 5	93/9	85/-	— ½
80,000	Do. do. do. 4½ % Cum. Pref.	£5	4½%	4½%	4½%	4½%	4⅜ — 5	4⅜ — 4⅞	96/3	88/9	— ⅛
40,000	Do. "City Undertaking" 4½ % Cum. Prf.	£5	4½%	4½%	4½%	4½%	4 — 4½	4 — 4½	..	..	..
40,000	Do. do. 1903	£5	..	4½%	4½%	4½%	4 — 4½	4 — 4½	..	..	..
420,000	Do. do. 4 % Deb. Stock Red.	£100	4 %	4 %	4 %	4 %	101 —103	101 —103	102	..	..
41,436	Chelsea Electricity Supply, Ord.	£5	4½%	5½%	6 %	6 %	5¼ — 5⅜	5¼ — 5⅜	5 1/16	5⅛	..
175,000£	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	107 —109	107 —109	109	..	..
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	£10	5 %	5 %	6 %	6 %	10¾ — 11⅛ xd	10¾ — 11	10 13/16	10⅜	— ¼
40,000	Do. 6 % Cum. Pref., 1 to 40,000	£10	6 %	6 %	6 %	6 %	13 — 14 xd	13 — 14	..	..	..
400,000£	Do. 5 % Db. Stk., Scrip. (iss. at 115) all pd.	..	5 %	5 %	5 %	5 %	123 —126	123 —126	..	..	..
300,000	Do. 4½ % 2nd Db. Stk., Prov. Crts., all pd.	£100	4½%	4½%	4½%	4½%	101 —103	101 —103	..	..	..
40,000	County of Durham Electrical Power, Ord.	£2	4 %	4 %	£3 7 0	4 %	1⅞ — 2⅛ xd	1⅞ — 2⅛	..	..	..
50,000	Do. do. do. 5 % Pref.	£5	5 %	5 %	5 %	5 %	5 — 5½ xd	5 — 5½	5 5/16	..	..
40,000	County of London Electric Lighting, Ord. 1—40,000	£10	4 %	4 %	4½%	5 %	8 — 9 xd	8 — 9	..	..	..
80,000	Do. do. 6 % Pref., 40,001—60,000	£10	6 %	6 %	6 %	6 %	11½ — 12½ xd	11¼ — 12¼	11⅞	..	— ¼
400,000£	Do. do. 4½ % Deb. Stock	..	4½%	4½%	4½%	4½%	109 —112	109 —112	110½	..	..
400,000	Do. do. 4½ % 2nd Deb. Stock	Stock	4½%	4½%	4½%	4½%	101 —103	101 —103	..	..	..
80,000	Edmundson's Electric Corporation, Ord. Shares	£5	7 %	7 %	7 %	5 %§	3⅜ — 4½	3⅜ — 4½	..	..	..
80,000	Do. do. 6 % Cum. Pref.	£5	6 %	6 %	6 %	6 %	5 — 5½	5 — 5½	..	..	..
320,000	Do. do. 4½ % 1st Mort Deb. Stk	£100	4½%	4½%	4½%	4½%	103 —106	103 —106	..	..	..
10,000	Folkestone, 1 to 10,000	£5	..	5½%	5½%	5½%	5½ — 5⅝	5½ — 5⅝	..	..	..
10,000	Do. 5 % Cum. Pref., 1 to 10,000	£5	..	..	..	5 %	5 — 5⅛ xd	5 — 5⅛	..	..	..
75,000	Do. 4½ % 1st. Deb. Stock	£100	..	4½%	4½%	4½%	101 —104	101 —104	..	..	..
13,000	Hove, 1 to 13,000	£5	..	8½%	8½%	9 %	8⅜ — 9	8⅜ — 9	..	..	..
10,000	Do. New (£5 10s. paid)	£3	..	8½%	8½%	9 %	8⅜ — 9	8⅜ — 9	..	..	..
37,300	Do. 4 % Deb. Stock	£100	..	4 %	4 %	4 %	98 —101	98 —101	..	..	..
7,300	Do. 4½ % Deb. Stock	£100	..	4½%	4½%	4½%	98 —101	98 —101	..	..	..
21,000	Kensington and Knightsbridge Electric Ord.	£5	10 %	12%	12 %	10 %	9½ — 10½	9½ — 10½	..	..	..
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	98 —101	98 —101	..	..	..
111,000	London Electric Supply Corporation, Limited, Ord.	£3	Nil	Nil	3 %	4 %	2 — 2½	2 — 2½	..	..	..
60,000	Do. do. do. 6 % Pref.	£5	6 %	6 %	6 %	6 %	5 — 5⅝	5 — 5⅝	5 1/16	..	..
374,395	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4 %	4 %	4 %	4 %	98 —101	98 —101	..	..	..
200,000	Metropolitan Electric Supply, 1 to 100,000	£5	7½%	8⅜%	10 %	10 %	8½ — 9½ xd	8⅜ — 9½	8¾	8½	..
76,121	Do. 4½ % Cum. Pref. 1—71,106, £3 pd.	£5	4½%	4½%	4½%	4½%	5⅝ — 5⅞	5⅝ — 5⅞	..	..	..
220,000£	Do. 4½ % 1st Mort. Deben. Stock	..	4½%	4½%	4½%	4½%	110 —114	110 —114	..	..	..
250,000£	Do. 3½ % Mort. Deben. Stock Redem.	Stock	3½%	3½%	3½%	3½%	95 — 97	95 — 97	..	..	..
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	£100	4½%	4½%	4½%	4½%	101 —103 %	101 —103	..	..	..
75,000	Newcastle-on-Tyne, 1 to 75,000	£5	..	8 %	8 %	8 %	7⅞ — 8⅛ xd	7⅞ — 8⅛	..	..	..
75,000	Do. 5 % Pref., 1 to 75,000	£5	..	5%	5 %	5 %	6¼ — 6⅜	6 — 6¼	..	..	— ¼
10,852	Notting Hill Electric Lighting	£10	6 %	6 %	7 %	7½%	13 — 14	13 — 14	..	..	..
64,000	Do. do. 4 % 1st Mort.Deb.	£100	4 %	4 %	4 %	4 %	97 — 99 xd	97 — 99	..	..	..
18,500	Oxford, 1 to 96 and 407 to 18,810	£5	..	6½%	7 %	7 %	6½ — 7	6½ — 7	..	..	..
50,000	Do. 4 % Deb. Stock	£100	..	4 %	4 %	4 %	99 —101	99 —101	..	..	..
40,000	St. James' and Pall Mall Electric Light, Ord.	£5	14½%	14½%	14½%	12½%	9 — 10	9 — 10	9¾	9½	..
20,000	Do. do. 7 % Pref. 20,081 to 40,080	£5	7 %	7 %	7 %	7 %	7 — 8	7 — 8	..	..	..
150,000£	Do. do. 3½ % Deb. Stock Red.	£100	3½%	3½%	3½%	3½%	96 — 98	96 — 98	..	..	..
12,000	Smithfield Markets Electric Supply, Ord.	£5	2½%	4 %	4 %	4 %	2¼ — 2¾	2¼ — 2¾	..	..	..
60,000	Do. do. do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	76 — 80	76 — 80	..	..	..
66,000	South London Electricity Supply, Ord.	£5	13⅓%	8 %	4 %	4 %	3 — 3½ xd	3 — 3¼	..	..	..
103,700	South Met. Elec. Lt. & Power (Ord.	£1	Nil	Nil	Nil	2½%	3/4 — 7/8	3/4 — 7/8	..	..	..
85,368	*(Late Blackheath and Greenwich* (7 % Pref.	£1	Nil	7 %	7 %	7 %	1¼ — 1⅜	1¼ — 1⅜	25/7½	..	..
148,292	*Dist. E.L.Co.)* (4½ % 1st Deb. Stk.	£100	4½%	4½%	4½%	4½%	103 —106 xd	103 —106	..	..	..
50,000	Urban Electric Supply, Ord.	£5	5 %	5 %	5 %	5 %	4⅛ — 4⅜ xd	4⅛ — 4⅜	..	..	..
30,000	Do. do. 5 % Cum. Pref.	£5	5 %	5 %	5 %	5 %	4⅜ — 5⅛ xd	4 3/16 — 5 1/16	..	..	— 1/16
200,000	Do. do. 4½ % 1st Mort. Db. Stk. Red	£100	..	..	4½%	4½%	102 —104 xd.	102 —104	102½	..	..
110,000	Westminster Electric Supply, Ord.	£5	12 %	13⅓%	14 %	13 %	9½ — 10½	9½ — 10½	10	9 11/16	..
28,151	Do do. 4½ % Cum. Pref. (Originally 5 %—Red. to 4½ % from 31st Dec., 1905.)	£5	5 %	5 %	5 %	5 %	5 1/16 — 5 1/16	5 1/16 — 5 1/16	5 1/16	5 1/16	..

Shares not officially quoted :—Mackay Companies, ord., 64—65. Pref. 75½—76½.
† Unless otherwise stated all shares are fully paid. § Interim dividends.

(Bank rate of discount 3½ per cent. (April 5th, 1906).

REVIEWS.

Steam Turbines: with an Appendix on Gas Turbines and the Future of Heat Engines. By Dr. A. Stodola. London: Archibald Constable & Co. 1905. Price 21s. net.

Our feeling on laying down Dr. L. C. Loewenstein's translation, from the second German edition of Prof. Stodola's work on steam turbines, is that of admiration for the painstaking work of the author. Whether the steam turbine is, or is not, the passing fashion which some consider it to be, the present activity in turning out turbines in manufacturers' workshops, together with the vast amount of experimental work which is now taking place, renders this translation particularly opportune. It serves throughout to afford to the designer of and experimenter with turbines a concise view of the scientific aspect of the question. Only too often are steam turbine experiments undertaken with badly designed blades and nozzles, and dangerous conditions of rotation. The author's preface to the first German edition, although written two years ago, applies to turbine builders with even more weight to-day than when it was penned. In it he says :—

"The great majority of those concerned will witness with indifference the economic loss of one of their number conducting a fruitless experiment; but to thoughtful men, such an occurrence, which is, unfortunately, only too frequent, is regarded as a common loss, even without considering the fact that no one would like to be placed in a similar position. Steam turbine building especially affords numerous examples of the necessity of combining constructive activity with scientific principles. For instance, we might refer to the importance of previously determining the exact dimensions of a rotating wheel whose periphery reaches almost the velocity of a bullet, in order that the existing stresses in the material do not at any place exceed the allowable limits. Or, again, how disadvantageous it would be in the case of the horizontally rotating disk wheels that have lately come into use, and whose diameters attain considerable dimensions, to determine experimentally after first constructing, how much the disks deflect on account of their own weight, and how much they again straighten out due to their centrifugal force; the latter a point of great importance, if we consider the scraping of the blades in the narrow clearance. What dangers the designer risks when he attempts the building of steam turbines without having exact knowledge of the phenomena of the so-called critical velocity. Finally, we could ask, is it 'economical' even to apply for a patent for a certain turbine system in which the greater part of the attainable work is destroyed before the steam has even reached the rotating wheel?"

The general contents are arranged in the following order:—(1) Elementary Theory of the Steam Turbine, (*a*) Axial Turbines; (*b*) Radial Turbines. (2) Theory of the Steam Turbine Thermodynamically Considered, (*a*) The Steady Flow of Steam; (*b*) The Laws of Energy in Axial and Radial Turbines; (3) Construction of the most Important Turbine Parts, and the Critical Angular Velocity of a Multiple Loaded Shaft. (4) Steam Turbine Types. (5) Special Problems of Steam Turbine Theory and Construction. There is an Appendix on the "Future of the Heat Engine." As may be judged from the foregoing, the book appeals chiefly to the designer who is a mathematician, and its one defect is an absence of detail concerning the mechanical features of some of the variations of the Parsons turbine which have lately come to the front.

A special feature is the Appendix, which, being concerned with future progress, is mainly speculative, but consists of speculation built on sound premisses. At the very outset the author warns his readers against perpetual motion engines of two types; in the first class we have machines that create work, *i.e.*, that produce work from nothing, or deliver more work than is brought into them; in the second class we have machines that undertake to transform heat into work, without changing anything else in the surroundings. In regard to the first, the words "conservation of energy" supply the answer to the re-discoverers of this mare's nest. The second is a more insidious fallacy. "The second fundamental law of thermo-dynamics says that this perpetual motion of the second type is impossible even with ideal machines—that is, even with frictionless non-conducting engines. . . . The proof for this law is not an absolute one; it is cumulative—that is, the results hitherto derived from it have without exception been confirmed by experience . . . . The entirely false conception of how a law of nature must be "proved" has led many inventors to believe, in direct contradiction to the second fundamental law of thermo-dynamics, that their invention is an exception, thereby destroying the truth of the law. . . . This second law is found to represent a controlling principle of all natural phenomena, and has, scientifically speaking, the same degree of certainty as the law of conservation of energy. . . . Over the entire remaining region of scientific research the law has been confirmed by innumerable experiments. Therefore, we may earnestly urge the inventor not to spend his means in carrying out any idea that would contradict the second law of thermo-dynamics."

Further on we have a recital of the leading fundamental laws governing the energy utilisation of heat engines of any type, worded as follows :—

"1. Decreasing the passive resistances, such as friction, throttling, &c., avoiding heat losses of every type.

"2. Adding the heat or conducting the combustion at the highest possible temperature, abstracting the heat at the lowest practicable temperature, avoiding to the greatest possible extent non-reversible changes of condition.

"3. Utilisation of the given-off heat and the application of regenerators where the kind of combustible and the work processes permit, so long as we can construct practical and efficient regenerators."

Various suggestions for securing these conditions are dealt with, among which is what the author terms a *cycle process with permanent superheat*, in which highly superheated steam expands isothermally with constant further heating. The only recorded attempt to secure this is that of Pictet, who injected hydro-carbons into a highly-heated and compressed mixture of steam and air, igniting them and using the products in a piston motor for the performance of work. Working non-condensing, Pictet's device becomes a petroleum motor with water injection (a project which, although Dr. Stodola does not mention the fact, is, we believe, almost as old as the Otto cycle). Working condensing Pictet's device would need larger auxiliary machinery for the air pump and compressor, a result which would absorb all the advantages given by the process.

Multiple fluid steam engines are discussed, and an interesting account is given of the troubles met with in practice with Josse's sulphurous acid engine. But this, together with a eulogy of the thermodynamic achievements of the Diesel type of engine, and Lorenz's striking presentment of the electro-chemistry of the direct production of electricity from coal, must be left for the reader's own perusal.

With regard to the gas turbine, the author is not quite so pessimistic as was Mr. Dugald Clerk in a recent utterance, but says what should suffice to deter many would-be inventors :—"Only when the mechanical efficiency of the compression reaches an exceedingly good value, and when the utilisation of the flow energy in a turbine has been considerably increased, or when substances have been found of sufficient stability beyond red heat, will the gas turbine be taken up in the industrial world."

We can only accord unstinted praise to this excellent work. Primarily it is a designer's hand-book, but it has a high value for the reasons we have stated. Dr. Stodola has already issued a third and larger German edition of his work. The English translation of that edition will be awaited with interest. Meanwhile the present volume will supply the needs of all save, perhaps, a score of designers desirous of keeping ahead of Continental progress, by learning all that that progress has to teach, and considering it in the light of their own experience.

Modern Turbine Practice and Water-Power Plants. By John Wolf Thurso. London: Constable & Co. 1906. Price 16s. net.

This book is very practical. The author commences by giving an explanation of the uniform symbol methods he uses throughout the book, and he follows this by a short glossary of technical terms. He is a believer in European turbine methods rather than American methods, and yet one has always heard such wonderful stories of the efficiencies of American turbines in the testing flume at Holyoke. It appears that the manner of this testing is as follows: All turbines are tested under a head of only some 20 ft., and from the high efficiency thus obtained they are claimed by their makers to be of that efficiency, whereas, under the head for which they are intended to work, they may be far from efficient. The author condemns such crude methods very properly, as also the American habit of making the same wheel for all falls. In France, where the turbine has not kept up with its early promise, and makers of turbines copy even American patterns, they do not go so far as this, for one of the largest manufacturers offers four series to suit heads from 1 metre to 60 metres. It even appears to be the case that the tested turbine at Holyoke is specially smoothed and polished, and exceeds the commercial article in efficiency. The author considers that a guarantee should be given for an efficiency test in place. He quotes a case where the maker was willing to guarantee an efficiency of 80 per cent. for a turbine tested in the Holyoke flume, but would only guarantee 73 per cent. if it was to be tested in place under the head of 110 ft.

This from an American or Canadian author, as we take him to be, shows that turbine construction is not of a high order over there; it may be that this is due partly to the fact that so many falls have an excess of water, and it may be due partly to the want of competition with good European examples.

Early in the book comes a chapter on the steam turbine. It seems out of place, and would have been perhaps as well omitted, for nobody is going to buy this book for what it says on steam turbines, it being too largely a water turbine treatise.

In the section on turbine installations it appears that all the wheels described and illustrated are European. No English example is given, though we fancy there are no better wheels to be obtained than those of Gunther, of Oldham, or the vortex wheel of Gilkes, of Kendal. Of the latter wheel the author hardly seems to be aware, for we find no reference to the vortex wheel as such. American inward flow turbines are regulated by that crude expedient, the cylinder gate, whose only recommendation is that it is cheap. It is only at full gate opening, however, that the author claims the American type of wheel to be a vortex. The true vortex wheel is, of course, a very different affair, and has very different guide blades, few in number, and carefully curved and pivoted.

This book is not a guide to the design of turbines. Perhaps the author considers it sufficient to leave design to manufacturers. He deals rather with general installations, and these are illustrated in many cases.

From this he passes to the subject of accessories, discussing "draft tubes," stop valves, which are usually gate valves in America, throttle valves, governors, and speed regulation. Regulation of a turbine is difficult, because water is heavy and inelastic, and the flow of water in a pipe cannot be checked without raising its pressure—perhaps dangerously. Relief valves with long movement are advised, to relieve pressure in the penstock should the wheel gate be closed. The Lombard valve is described, and also the by-pass device, which is better in some ways, but less economical. Stand pipes are also advised, and fly-wheels are recommended to steady the turbine, though they cannot, of course, help the penstock in the way of pressure relief. No mention is made of the use of an air vessel to relieve pressure, and to assist in maintaining or starting a good flow of water after a considerable check in the demand.

In Part II the civil engineering part of the subject is dealt with in the way of tail races, conduits or head races, gates and so on, and then the general question of the development of a water power is dealt with. A few good remarks are made on anchor ice and frazil.

An appendix is added in the shape of a paper by A. V. Garratt, in which the dynamics of water receive attention, and here we find some good words for the air vessel if large enough and if kept full of air by a pump, for air disappears so soon into water under pressure. There should be no difficulty in restraining this absorptive action. Would not a slight addition of paraffin or oil into the air chamber serve as a shield between air and water?

As a general word we should say this is a book for the power engineer who does not wish to design wheels but works; he will design his works from the flow of water necessary for a wheel of a given power at a given efficiency, and this efficiency he will have to specify, and it must be proved in place. To this engineer the book will be valuable.

Steam Turbines: Their Development, Styles of Build, Construction and Use. By Wilhelm Gentzch. Translated from the German by Arthur R. Liddell. London: Longmans, Green & Co. 1906. Price 21s. net.

We must confess that it is possible to learn more concerning steam turbine problems from more concise publications than is contained in the 367 pages and 637 illustrations of this book. Not that we would imply that the labours of the author, who apparently holds (or held) a position in the German Patent Office, are wholly vain. Such an implication would be unjust to a conscientiously compiled catalogue of patent abstracts and patent drawings, which enumerates the good, bad and indifferent to a length not before attempted.

So far as the translator is concerned, his work, on the whole, has been done but moderately well. Why such a literal Teutonism as "styles of build" in the very title? Or, on p. 7, why the sentence, "He obtained an efficiency of 20 E.H.P. at a speed of 5,000 r.p.m., and a steam consumption of 40 lb. per E.H.P." ?—a misuse of the term efficiency which is repeated on page 157. Again, why the repeated use of the term conaxial? Euphonically, its use might be defended, but it lacks the precedent of text-book use, which is more important than the hall-mark of dictionary mention. A sentence taken at random from page 281, in which we read "a prevention of the unintended passage of the steam by the pressure of the surfaces one upon another has to be given up," is not quite happily expressed. A page or two further we read of a "pressureless jet of steam"—a too-Teutonic rendering for steam which has expanded to a point of partial vacuum.

Passing from the delinquencies of the translator to those of that more important personage, the author, we have to remind the latter that science is cosmopolitan. This the author seems to have failed to realise. Infected by the anti-Parsons spirit, which is rather marked in Germany, he has time after time given first place in his chapters on specific details to an invention relating thereto patented recently by one of his own nationality, setting this quite out of its chronological order, and giving second or third mention to considerably earlier patents in the name of Parsons.

The compilation, as a whole, savours of the files of the patent office rather than of the manufacturer's drawing office. As a record of patents, arranged under various headings, it is, despite a questionable classification of pressure and velocity turbines, likely to be of considerable value, and will probably be used to discomfit several would-be inventors of new (?) devices in connection with steam turbines.

Alternating Currents: Their Theory, Generation and Transformation. By Alfred Hay, D.Sc., M.I.E.E. London and New York: Harper & Bros. 1905. Price 6s. net.

A book by Dr. Hay on "Alternating Currents" will naturally find its way to the book shelves of every electrical engineer, whether his knowledge of alternating current theory be superficial or profound. To readers of *Science Abstracts* the initials "A. H.," besides being the most familiar, are always a guarantee that the abstract is interesting, and many of us have made our first acquaintance with novel points in theory and practice in these abstracts. Our only complaint

against the book is that it is too short, and consequently many things of importance to beginners have to be omitted, but this, we fancy, is the feature that will recommend it most to the working electrician for whom it is intended.

The book describes in a general manner the principles and construction of measuring instruments, generators, motors, transformers and converters. It contains good descriptions of instruments and machines recently invented which have not been previously described in any text-book, and the author clears up successfully many of the theoretical difficulties which hamper the practical engineer. He very properly, since the book is elementary, explains principles on the sine wave assumption, but he carefully points out, when necessary, the limitations this introduces into the theory.

The author uses the word "auto-transformer" as being the equivalent of compensator. It would, perhaps, be better to make a distinction between the two, and better still to drop the first word altogether. The dispersion coefficient of an induction motor is defined after Heyland and Behrend. Personally, we much prefer Potier and Behn-Eschenburg's definition as, when the transformer analogy is fully worked out, the equations are much simpler.

In conclusion, we must mention that there are many constructional details clearly described in the book which are not to be found elsewhere. We have much pleasure in recommending the book to electricians.

The Alternating Current Circuit and Motor. By W. Perren Maycock. London: Whittaker & Co. Second and Enlarged Edition. 1905. Price 4s. 6d. net.

The second edition of this work is more than double the size of the first, a considerable amount of new matter concerning polyphase and single-phase motors having been added. This book is intended for those who have difficulty in understanding the mathematical language in which the theory is usually clothed, and the author states that he will be satisfied if it lead young students and those ignorant of mathematics to take something more than a superficial interest in alternating current work. The task the author has set himself to accomplish is by no means an easy one, and a second edition being called for is *primâ façie* evidence that he has been at least partially successful. The alternating current circuit studied without mathematics reminds one of the play of Hamlet with the Prince of Denmark excluded. We think that parts of the book are helpful to the beginner, and that parts may mislead him. It will, therefore, be instructive to dwell upon the latter.

It is stated that the original portion of the work has been subjected to a careful revision. There are, however, a good many misprints and errors still left in it. As early as p. 3 we have undirectional written for unidirectional. This might easily puzzle a beginner. On p. 71 we read that reactance varies as inductance divided by capacity! And on the next page, that impedance varies as resistance plus reactance. These statements are, of course, quite erroneous, and are contradicted by the correct statements given on p. 97. In several places there is a lack of precision about the words chosen. For instance, we are told that "the momentum of the water expends its energy on the pipe." In dynamics, momentum means mass multiplied by velocity, and although it is obvious what the author means, it is a pity that he does not express it otherwise. He also uses "strain" in the sense of "stress," but this may be intentional, as in several cases he slightly alters the usual definitions. It is stated in a foot-note to p. 94 that the formula for reactance ($2\pi nL$) requires for its proof the differential calculus. It is an easy task, however, to devise an elementary proof, and many have been given.

We agree (p. 101) that the idea of a "wattless current" is difficult to grasp, but to offer an analogy giving "a rough but useful explanation" is certainly misleading. It serves no useful purpose to give mechanical analogies of mathematical fictions. We think that the analogies have been elaborated too far, and we are not at all impressed or instructed by Prof. Forbes's mechanical devices. The reader gets the impression that the whole theory is based on the shakiest foundations. It would have been sufficient merely to explain that self-inductance acts like inertia, and a condenser acts like a spring.

It is doubtful whether it does any good to explain to the elementary student the theory of the phenomena of skin resistance when he has only the haziest notions of self and mutual inductance. On p. 88 it is stated that "Lord Kelvin has shown that in the case of a current at a frequency of 150, the current penetrates the copper conductor to a depth of about 3 millimetres only." Similar statements are to be found in much more pretentious books. The problem Lord Kelvin discusses is the following:—A long straight cylindrical rod forming the inside conductor of a concentric main carries an alternating current. In this case, owing to some of the lines of force being linked to more filaments of current than others, the density of the current varies over the cross-section of the conductor.

All filaments of current at the same distance from the axis of the conductor are in the same phase, and have the same amplitude. We can therefore picture the current in the conductor as being built up of concentric cylindrical sheets. When the frequency is high, some of these sheets are flowing in one direction, and others in the opposite direction. The current in the conductor at any instant is the algebraical sum of these currents, and so the power wasted in heating the conductor is greater than that expended by a direct current equal to the effective value of the sum of the alternating currents.

He proves also that the effective value of the intensity of the current is a maximum at the surface, and that it steadily diminishes as we approach the axis. Even along the axis the effective value of the current is never zero. The "depth of 3 millimetres" refers to the thickness of a hollow cylinder of the same outside diameter as the given conductor, along which if a steady current, whose magnitude equals the effective value of the alternating current, flows, the power expended will be the same as in the alternating current case. The author's explanations of the Kelvin effect although ingenious are quite inadequate, and may well prove quite misleading.

The latter part of the book treats of the polyphase motor, and we think that it will be appreciated by youthful electricians. The diagrams, of which there are 140, are clearly drawn and instructive. We have searched in vain for the "firm line arrows" referred to in fig. 91. We hope that in the next edition the author will make a radical revision of the early part of the work. It would be quite easy to make it scientifically correct, and it would well repay the trouble. Perhaps it would be advisable not to attempt to explain the theory of the skin effect to beginners.

Dynamo-Electric Machinery. By S. P. Thompson, D.Sc., F.R.S. Vol. II, Alternating-Current Machinery. Seventh edition. London: E. & F. N. Spon, Ltd. 1905. Price 30s. net.

Dr. Thompson's "Dynamo-Electric Machinery" is unquestionably the leading treatise on this subject. Each successive edition bears renewed evidence of the care with which its author has now for very many years placed before students and engineers, the results of his work and study in this branch of electrical engineering. Nine years have elapsed since the publication of the sixth edition. The volume before us comprises the second half of the seventh edition, and is devoted to the subject of "Alternating-Current Machinery." This sub-division into two volumes is of especial advantage to the second volume since, the historical treatment having already been covered in the first volume, the reader's interest is secured from the very first pages.

Allusion is made on p. 3 to the flickering of glow lamps at low periodicities, and 20 cycles is mentioned as a rough limit. It would have been well to point out that glow lamps, if of low candle-power and high voltage, may flicker at higher periodicities.

Thus a 250-volt carbon filament lamp for a given candle-power will begin to flicker at a much higher periodicity than would be the case with a 125-volt lamp of the same candle-power. For this reason the Oerlikon Co. (*Elektrische Bahnen*, January 24th, 1906, p. 46), employ 20-volt glow lamps for lighting their single-phase rolling-stock, which is operated from a 15-cycle trolley line.

Modern Turbine Practice and Water-Power Plants. By John Wolf Thurso. London: Constable & Co. 1906. Price 16s. net.

This book is very practical. The author commences by giving an explanation of the uniform symbol methods he uses throughout the book, and he follows this by a short glossary of technical terms. He is a believer in European turbine methods rather than American methods, and yet one has always heard such wonderful stories of the efficiencies of American turbines in the testing flume at Holyoke. It appears that the manner of this testing is as follows: All turbines are tested under a head of only some 20 ft., and from the high efficiency thus obtained they are claimed by their makers to be of that efficiency, whereas, under the head for which they are intended to work, they may be far from efficient. The author condemns such crude methods very properly, as also the American habit of making the same wheel for all falls. In France, where the turbine has not kept up with its early promise, and makers of turbines copy even American patterns, they do not go so far as this, for one of the largest manufacturers offers four series to suit heads from 1 metre to 60 metres. It even appears to be the case that the tested turbine at Holyoke is specially smoothed and polished, and exceeds the commercial article in efficiency. The author considers that a guarantee should be given for an efficiency test in place. He quotes a case where the maker was willing to guarantee an efficiency of 80 per cent. for a turbine tested in the Holyoke flume, but would only guarantee 73 per cent. if it was to be tested in place under the head of 110 ft.

This from an American or Canadian author, as we take him to be, shows that turbine construction is not of a high order over there; it may be that this is due partly to the fact that so many falls have an excess of water, and it may be due partly to the want of competition with good European examples.

Early in the book comes a chapter on the steam turbine. It seems out of place, and would have been perhaps as well omitted, for nobody is going to buy this book for what it says on steam turbines, it being too largely a water turbine treatise.

In the section on turbine installations it appears that all the wheels described and illustrated are European. No English example is given, though we fancy there are no better wheels to be obtained than those of Gunther, of Oldham, or the vortex wheel of Gilkes, of Kendal. Of the latter wheel the author hardly seems to be aware, for we find no reference to the vortex wheel as such. American inward flow turbines are regulated by that crude expedient, the cylinder gate, whose only recommendation is that it is cheap. It is only at full gate opening, however, that the author claims the American type of wheel to be a vortex. The true vortex wheel is, of course, a very different affair, and has very different guide blades, few in number, and carefully curved and pivoted.

This book is not a guide to the design of turbines. Perhaps the author considers it sufficient to leave design to manufacturers. He deals rather with general installations, and these are illustrated in many cases.

From this he passes to the subject of accessories, discussing "draft tubes," stop valves, which are usually gate valves in America, throttle valves, governors, and speed regulation. Regulation of a turbine is difficult, because water is heavy and inelastic, and the flow of water in a pipe cannot be checked without raising its pressure—perhaps dangerously. Relief valves with long movement are advised, to relieve pressure in the penstock should the wheel gate be closed. The Lombard valve is described, and also the by-pass device, which is better in some ways, but less economical. Stand pipes are also advised, and fly-wheels are recommended to steady the turbine, though they cannot, of course, help the penstock in the way of pressure relief. No mention is made of the use of an air vessel to relieve pressure, and to assist in maintaining or starting a good flow of water after a considerable check in the demand.

In Part II the civil engineering part of the subject is dealt with in the way of tail races, conduits or head races, gates and so on, and then the general question of the development of a water power is dealt with. A few good remarks are made on anchor ice and frazil.

An appendix is added in the shape of a paper by A. V. Garratt, in which the dynamics of water receive attention, and here we find some good words for the air vessel if large enough and if kept full of air by a pump, for air disappears so soon into water under pressure. There should be no difficulty in restraining this absorptive action. Would not a slight addition of paraffin or oil into the air chamber serve as a shield between air and water?

As a general word we should say this is a book for the power engineer who does not wish to design wheels but works; he will design his works from the flow of water necessary for a wheel of a given power at a given efficiency, and this efficiency he will have to specify, and it must be proved in place. To this engineer the book will be valuable.

Steam Turbines: Their Development, Styles of Build, Construction and Use. By Wilhelm Gentzch. Translated from the German by Arthur R. Liddell. London: Longmans, Green & Co. 1906. Price 21s. net.

We must confess that it is possible to learn more concerning steam turbine problems from more concise publications than is contained in the 367 pages and 637 illustrations of this book. Not that we would imply that the labours of the author, who apparently holds (or held) a position in the German Patent Office, are wholly vain. Such an implication would be unjust to a conscientiously compiled catalogue of patent abstracts and patent drawings, which enumerates the good, bad and indifferent to a length not before attempted.

So far as the translator is concerned, his work, on the whole, has been done but moderately well. Why such a literal Teutonism as "styles of build" in the very title? Or, on p. 7, why the sentence, "He obtained an efficiency of 20 E.H.P. at a speed of 5,000 r.p.m., and a steam consumption of 40 lb. per E.H.P." ?—a misuse of the term efficiency which is repeated on page 157. Again, why the repeated use of the term conaxial? Euphonically, its use might be defended, but it lacks the precedent of text-book use, which is more important than the hall-mark of dictionary mention. A sentence taken at random from page 281, in which we read "a prevention of the unintended passage of the steam by the pressure of the surfaces one upon another has to be given up," is not quite happily expressed. A page or two further we read of a "pressureless jet of steam"—a too-Teutonic rendering for steam which has expanded to a point of partial vacuum.

Passing from the delinquencies of the translator to those of that more important personage, the author, we have to remind the latter that science is cosmopolitan. This the author seems to have failed to realise. Infected by the anti-Parsons spirit, which is rather marked in Germany, he has time after time given first place in his chapters on specific details to an invention relating thereto patented recently by one of his own nationality, setting this quite out of its chronological order, and giving second or third mention to considerably earlier patents in the name of Parsons.

The compilation, as a whole, savours of the files of the patent office rather than of the manufacturer's drawing office. As a record of patents, arranged under various headings, it is, despite a questionable classification of pressure and velocity turbines, likely to be of considerable value, and will probably be used to discomfit several would-be inventors of new (?) devices in connection with steam turbines.

Alternating Currents: Their Theory, Generation and Transformation. By Alfred Hay, D.Sc., M.I.E.E. London and New York: Harper & Bros. 1905. Price 6s. net.

A book by Dr. Hay on "Alternating Currents" will naturally find its way to the book shelves of every electrical engineer, whether his knowledge of alternating current theory be superficial or profound. To readers of *Science Abstracts* the initials "A. H.," besides being the most familiar, are always a guarantee that the abstract is interesting, and many of us have made our first acquaintance with novel points in theory and practice in these abstracts. Our only complaint

against the book is that it is too short, and consequently many things of importance to beginners have to be omitted, but this, we fancy, is the feature that will recommend it most to the working electrician for whom it is intended.

The book describes in a general manner the principles and construction of measuring instruments, generators, motors, transformers and converters. It contains good descriptions of instruments and machines recently invented which have not been previously described in any text-book, and the author clears up successfully many of the theoretical difficulties which hamper the practical engineer. He very properly, since the book is elementary, explains principles on the sine wave assumption, but he carefully points out, when necessary, the limitations this introduces into the theory.

The author uses the word "auto-transformer" as being the equivalent of compensator. It would, perhaps, be better to make a distinction between the two, and better still to drop the first word altogether. The dispersion coefficient of an induction motor is defined after Heyland and Behrend. Personally, we much prefer Potier and Behn-Eschenburg's definition as, when the transformer analogy is fully worked out, the equations are much simpler.

In conclusion, we must mention that there are many constructional details clearly described in the book which are not to be found elsewhere. We have much pleasure in recommending the book to electricians.

The Alternating Current Circuit and Motor. By W. Perren Maycock. London: Whittaker & Co. Second and Enlarged Edition. 1905. Price 4s. 6d. net.

The second edition of this work is more than double the size of the first, a considerable amount of new matter concerning polyphase and single-phase motors having been added. This book is intended for those who have difficulty in understanding the mathematical language in which the theory is usually clothed, and the author states that he will be satisfied if it lead young students and those ignorant of mathematics to take something more than a superficial interest in alternating current work. The task the author has set himself to accomplish is by no means an easy one, and a second edition being called for is *primâ facie* evidence that he has been at least partially successful. The alternating current circuit studied without mathematics reminds one of the play of Hamlet with the Prince of Denmark excluded. We think that parts of the book are helpful to the beginner, and that parts may mislead him. It will, therefore, be instructive to dwell upon the latter.

It is stated that the original portion of the work has been subjected to a careful revision. There are, however, a good many misprints and errors still left in it. As early as p. 3 we have undirectional written for unidirectional. This might easily puzzle a beginner. On p. 71 we read that reactance varies as inductance divided by capacity! And on the next page, that impedance varies as resistance plus reactance. These statements are, of course, quite erroneous, and are contradicted by the correct statements given on p. 97. In several places there is a lack of precision about the words chosen. For instance, we are told that "the momentum of the water expends its energy on the pipe." In dynamics, momentum means mass multiplied by velocity, and although it is obvious what the author means, it is a pity that he does not express it otherwise. He also uses "strain" in the sense of "stress," but this may be intentional, as in several cases he slightly alters the usual definitions. It is stated in a foot-note to p. 94 that the formula for reactance ($2\pi nL$) requires for its proof the differential calculus. It is an easy task, however, to devise an elementary proof, and many have been given.

We agree (p. 101) that the idea of a "wattless current" is difficult to grasp, but to offer an analogy giving "a rough but useful explanation" is certainly misleading. It serves no useful purpose to give mechanical analogies of mathematical fictions. We think that the analogies have been elaborated too far, and we are not at all impressed or instructed by Prof. Forbes's mechanical devices. The reader gets the impression that the whole theory is based on the shakiest foundations. It would have been sufficient merely to explain that self-inductance acts like inertia, and a condenser acts like a spring.

It is doubtful whether it does any good to explain to the elementary student the theory of the phenomena of skin resistance when he has only the haziest notions of self and mutual inductance. On p. 88 it is stated that "Lord Kelvin has shown that in the case of a current at a frequency of 150, the current penetrates the copper conductor to a depth of about 3 millimetres only." Similar statements are to be found in much more pretentious books. The problem Lord Kelvin discusses is the following:—A long straight cylindrical rod forming the inside conductor of a concentric main carries an alternating current. In this case, owing to some of the lines of force being linked to more filaments of current than others, the density of the current varies over the cross-section of the conductor.

All filaments of current at the same distance from the axis of the conductor are in the same phase, and have the same amplitude. We can therefore picture the current in the conductor as being built up of concentric cylindrical sheets. When the frequency is high, some of these sheets are flowing in one direction, and others in the opposite direction. The current in the conductor at any instant is the algebraical sum of these currents, and so the power wasted in heating the conductor is greater than that expended by a direct current equal to the effective value of the sum of the alternating currents.

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Thus a 250-volt carbon filament lamp for a given candle-power will begin to flicker at a much higher periodicity than would be the case with a 125-volt lamp of the same candle-power. For this reason the Oerlikon Co. (*Elektrische Bahnen*, January 24th, 1906, p. 46), employ 20-volt glow lamps for lighting their single-phase rolling-stock, which is operated from a 15-cycle trolley line.

In a footnote on p. 9, the author credits Dr. Fleming with finding, subsequent to 1894, that certain transformers worked with a distinctly higher efficiency when operated by an alternator giving a peaked curve than when operated by one giving a nearly pure sine curve of electromotive force. When and by whom this was first observed it may be hard to say. It is, however, certain that Ernst Danielson in 1891, when associated with the Thomson-Houston Electric Co., of Lynn, U.S.A., repeatedly measured and recorded core losses 10 per cent. higher for a given transformer when supplied from a smooth core (surface-wound) alternator than when supplied at the same pressure from an alternator with one slot per pole, and with its windings embedded in slots. The first observation of the discrepancy came as a surprise, and the wattmeter was sent to the standardising laboratory with the complaint that it was out of order.

Chapter II is devoted to a highly interesting study of periodic functions which do not follow a simple sine law. One misses, however, certain familiar features and the corresponding equation, which embellished the article when originally published last Spring in one of our engineering contemporaries.

In Chapter III, entitled "Alternators," some 40 pages are devoted to descriptions of Mordey's and Ferranti's early types, and to the equally obsolete inductor types with which most of the large manufacturing companies have burnt their fingers at one time or another. These descriptions take up valuable space, and as there is but little in the text of a nature to indicate that they are not standard practice, the consequence is that students employ their time endeavouring to acquire a knowledge of the least readily understood and least useful types. If students are so unfortunate as to succeed in assimilating this subject, they have simply so much more to unlearn in actual practice. There is, nevertheless, a great amount of useful matter in this chapter which, if it stands alone in the next edition, will enhance the value of the book from the educational standpoint. On p. 101 it is pointed out that polyphase generators are not only much lighter, and consequently cheaper, than single-phasers of the same type and output, but that the reactions due to the armature currents are relatively much less than is the case with single-phase machines. It is important that there should be a more general realisation of this point.

Chapters dealing with the calculation of E.M.F. and regulation and with winding schemes, prepare the way for Chapters VII and VIII, which deal with the design of alternators from the synthetical and analytical standpoints respectively. In the latter chapter, some 14 designs furnished by a number of manufacturing firms are given in considerable detail. The inclusion of elaborate tabulated data of this sort is one of the most important and useful innovations in the recent editions of Dr. Thompson's books. In the older books by various writers on this subject, a cursory glance through gave an impression that many valuable data were accessible. A more thorough attempt to compile the data was, however, almost invariably disappointing. Nowadays, really exhaustively complete data of fairly modern machines are published in these treatises of Dr. Thompson's, as also in those by Arnold and by Fischer-Hinnen. The reader rarely has the remotest conception of the vast amount of very careful and painstaking work involved in compiling such complete data specifications as he will find in Dr. Thompson's book.

One naturally turns with great interest to Chapter IX on Steam Turbine Alternators, and in spite of the rapidity of developments in this line, one also finds here a number of very complete descriptions of turbo-alternators, together with a highly interesting discussion of the subject.

The next few chapters deal with various types of transformers, comprising motor-generators, cascade converters, frequency changers, rotatory converters and static transformers. Most of these types are not only explained by the aid of examples from practice, but are also discussed from the designing standpoint.

The last 160 pages comprise a thorough treatment of polyphase and single-phase induction motors, and the data of some 11 designs from actual practice are analysed. Amongst these are some distinctly inferior designs; but this should do no harm, since by the time the reader has thoroughly assimilated the principles of the first 733 pages, it will be his own fault if he fails to discriminate.

It is to be hoped that another nine years will not be allowed to elapse between successive editions. In the form that the book has assumed in the present edition, it should be quite practicable every year to replace the less satisfactory examples from practice by new designs. The chapters in which Dr. Thompson has dealt with fundamental principles will always be up-to-date. Were a new edition to be brought out punctually once a year on this plan, it would always be certain of a cordial welcome.

High-Tension Power Transmission. A Series of Papers and Discussions presented at the Meetings of the American Institute of Electrical Engineers. New York: The McGraw Publishing Co. 1905. Price $3.00.

This book contains several papers and discussions which have appeared in the *Transactions* of the American Institute of Electrical Engineers during the past two years. All the papers treat of matters concerning the transmission of power by high pressure currents, and the meetings of the Institute at which they were presented were held directly under the auspices of the Committee on High-Tension Transmission. We welcome the appearance in one volume of these papers, originally scattered through many numbers of the *Transactions*, as by their publication in one book a great deal of valuable information is presented in a form most convenient for reference. Several of the papers deal with details of overhead construction, and particular attention is given to the insulation of lines for very high pressures, the limitation to the working voltage being at present fixed by the degree to which the line insulation can be carried out.

The first paper, which is by Mr. R. D. Mershon, deals with the standardisation of wooden insulator pins. Iron or steel pins for insulators have only recently been introduced in America, and as wooden pins are unknown in Europe, the subject is not of absorbing interest to engineers on this side of the Atlantic. It is just as well for us, however, that this paper should be included amongst the others, as most of the important installations in America have wooden pins for the transmission lines, and the paper is really a mathematical consideration of the fibre stresses in such pins, and a recommendation as regards standard dimensions and methods of construction. Proposed standard dimensions are given for pins of all lengths from those standing 5 in. above the cross arms to those standing 19 in. The burning of these same insulator pins comes in for treatment in another paper by Mr. Chesney. This has been a source of considerable trouble on some American lines, chiefly on those running along the coast and liable to salt deposits in the form of fine spray. A large number of burnt pins are illustrated, but it is in many cases difficult to account for the facts observed. The evils of pin burning are unlikely to trouble us in Europe, however, for the simple reason that we use only pins of iron or steel. In the newer lines the Americans are doing the same, so that pin burning is not likely to be much heard of in the future.

Insulators claim treatment in a paper by Mr. Blackwell, and the testing of these is fully dealt with. Attention is called to the fact that the shape of the potential wave has a pronounced effect in breaking down the insulation. A wave can be either flat topped or peaked, so that the maximum instantaneous pressure is much less or much greater than that of a sine wave of the same root mean square voltage. The pressure as read by the voltmeter, it is pointed out, is little guide to the maximum strain on the insulation, since, for the same indication on the instrument, the maximum pressures for different machines may differ as much as two to one. As affecting insulation considerations, it is noted that moisture in the atmosphere affects the arcing distance; in steam a given pressure will jump twice as far, and in fog 25 per cent. farther than under ordinary conditions. Also at an altitude where the air is rarefied, the arc will jump to a greater distance. In this paper on the testing of high tension insulators, a description of the usual tests is given, and it is suggested that the puncture test should be at twice the pressure for which the insulator is to be employed in practice. The pressure is to be applied

between the head where the wire is fastened on and the interior of the insulator where the pin goes, for one minute, and according to this standard, insulators intended to work on a 50,000-volt line will have to stand 100,000 volts. As on a 50,000-volt line the potential of any conductor to ground would be about 29,000 volts, the above test gives a factor of safety of nearly 3½ to 1. The necessity for testing a new form of insulator under conditions closely approaching those under which it will work when the line is erected, is insisted on. It is easy to imitate the conditions of wind and rain by employing a sprinkling nozzle supplied with water at a pressure of 50 lb. to the sq. in. and playing it on the insulator being tested at an angle of about 30° with the ground.

Still bearing on the subject of insulation, a paper by Mr. C. E. Skinner, and discussion, follow on bringing high tension conductors into buildings, and several illustrations of different methods are given. This is an important matter, as the combining of a perfectly satisfactory manner of taking the end strain of the line with the keeping up of the insulation to full line strength has not always been easy of attainment. A very usual method is to bring the wires through long insulating bushes mounted in a plate glass window, and lines working at a pressure of 60,000 volts have been dealt with quite satisfactorily in this way. Necessarily much depends on the amount of shielding which the wires require from the weather, as the less the shielding the easier is it to combine the two requirements above mentioned.

Amongst other things discussed is the protection of high pressure transmission lines from lightning discharges, and when we mention that the author of the paper introducing the subject was Mr. Wirt, it will be at once recognised that plenty of experience was brought to bear on the matter. Mr. Wirt was of opinion that the transmission line should be protected from lightning discharges by suitable apparatus placed in the station, and that it was not necessary to use grounded guard wires above the line, though he would make an exception in the case of lines on which the poles were shattered with great frequency. Nevertheless, we have here, as on all the subjects dealt with in this volume, many thoughts of many minds, and there is no doubt that grounded wires save the poles and act as a shield to prevent the potential of the line wires from rising to anything like the same as if the grounded wires were absent. There is every reason to believe that for main transmission lines in America steel tower construction will be largely adopted in the future, and with this the shattering of the poles due to lightning will altogether disappear. At the same time, with the higher pressures coming into use, the protection of the system generally becomes more difficult, and the discussion before us shows that there is by no means uniformity of opinion on the subject.

As bearing on the matter of steel tower construction, there is an interesting paper on long spans by Mr. F. O. Blackwell. The use of copper and aluminium wire is discussed, but the writer does not appear to arrive at any very definite conclusion as to which is the more advantageous. In the Guanajuato transmission line, instanced as the best example of a long span line in America, the steel towers are spaced 12 to the mile, or 440 ft. apart. A usual spacing for wooden poles is 40 to the mile, so that the insulators used with the steel construction are less than one-third as many. These being considered the weak points in the line, the reliability of operation is increased, due to their reduction as well as to the greater solidity of the towers themselves as compared with wooden poles. The discussion on this matter is one of the longest in the book, and brings out many important points.

Leaving overhead work, the operation and maintenance of high-tension underground systems, and the protection of cables from arcs due to failure of adjacent cables, are matters dealt with in other papers. A long and interesting discussion followed the reading of the former, in which each engineer taking part gave his experience, and indicated where he had found most of his troubles. There is a paper on the Y *versus* Δ connection of transformers, from the discussion on which it appears that opinions on the two ways of connecting up are equally divided. On the whole, the Y connection with grounded neutral appears to be favoured by the majority. The use of ground shields in transformers is, we observe, condemned by nearly all the engineers who took part in the discussion on this subject. Switching and automatic cut-out gears also come in for consideration in this work, as well as the effect of synchronous motors for rectifying the phase on long lines. With regard to the latter, it is mentioned in the discussion that when the Cauvery Falls-Kolar transmission line had reached the limit of its capacity, the installation of a 1,000-KW. rotary condenser enabled 50 per cent. more power to be transmitted over the line. It may be mentioned, however, that in a very long line, working at very high voltage, instead of a condenser being needed to compensate for self-induction, an inductance might be needed to compensate for the line charging current. Another matter of interest discussed is the choice of frequency for very long lines. The opener of the discussion shows in a table that, while a 200-mile three-phase line will deliver at 60,000 volts 4,500 KW. at 60 cycles, it will deliver 11,250 KW. at 25 cycles if the inductance voltage is, in both cases, 20 per cent. Every one knows, of course, that there is a great advantage in reducing the frequency for long-distance transmission, but it is a curious fact that the longest line in the world—the Bay Counties line in California — and the highest voltage line — the Missouri River Power Co. in Montana—are both operating at 60 cycles.

The report of the Committee on High-Tension Transmission is included in the book, and forms a fitting summary to the whole. This report gives a large amount of important information collected from the engineers in charge of power plants all over the States. We are of opinion that every one interested in the electrical transmission of power should possess a work of reference which gets into such small bulk so large an amount of valuable and practical information.

The Commercial Management of Engineering Works. By Francis G. Burton. Manchester: The Scientific Publishing Co. Second Edition. 1905. Price 12s. 6d. net.

Although the nature of one business varies too much from that of another to enable laws to be laid down for dealing with the question of organisation on the best lines, the remarks contained in this book, which covers the whole field in the direction of management of an industrial concern—namely, from the duties of the directors to those of the shop manager and foremen—will be of interest to those associated with the management and running of works.

The legal position of the directors, secretary and accountant according to our company law are first considered, and the inference will commend itself to many that the secretarial duties do not include interference in the every-day business of the concern. There is no doubt that the old-fashioned method of making a company secretary also the business manager is out of date. The Companies' Act, 1900, is reprinted, and will, no doubt, be of interest for reference purposes.

The lines of organisation traced out in this book assume that the business will be controlled by a board of directors, and managed by a general manager. Although there is some difference of opinion on this subject, we think the management of a limited company is better handled in this way than by allocating to some of the directors the duties of departmental managers, which is sometimes done. A director will not necessarily make a good departmental manager, and when once installed in this position, his removal is sometimes difficult, and at all times unpleasant; and this method is not to be recommended, excepting in the case of very large concerns, where the management cannot be vested in one individual.

It is doubtful whether the organisation laid down in the book appreciates sufficiently that modern industrial concerns require dividing into two parts, namely, the commercial and the executive, and that to all intents and purposes the executive must be subservient to the commercial.

There seems to be a notion in many quarters that a highly technical business, such as many of the engineering branches present, must necessarily be managed by engineers. Examples to be found in every-day life will, however, prove the fallacy of this, and a successful business will nowadays

be managed either by a commercial man, or by a commercial engineer. In either case it is a commercial spirit which is required to dominate a successful business.

There is a tendency in some quarters to carry a subdivision of the staff too far, and to create too many departments, without sufficient control. This invariably results in confusion, delay in dealing with matters, and often in friction between the departments concerned. This evil has been appreciated and avoided in the lines laid down in this book.

The duties of the general manager are outlined, and the scope of the drawing office and subordinate officials are touched on. The commercial department is rightly divided into two parts, namely, the purchase and the sales, and the various details setting forth the functions of these branches are outlined in some detail.

The latter part of the book is taken up in dealing with the duties of the works manager, and a good deal of space is devoted to the question of cost accounts, method and system of paying workmen, arrival at a proper prime cost basis, &c.

Whilst it would be folly to argue that the information contained in this book was likely to assist materially in turning a losing concern into a paying one, or to transform an ordinary individual into an organiser, it can, at all events, be commended to those interested in the working of industrial concerns, as containing much that will be of interest to them.

Practical Electric Wiring for Lighting Installations. By Charles C. Metcalfe. London : Harper and Bros. 1905. Price 5s.

In this work the author assumes some knowledge of electrical matters, and does not devote much space to the elements of the subject, but passes on rapidly to the instruction in wiring.

The chapters on "Fitting and General Arrangement" and "System" describe how the work should be done. A large number of illustrations are used, and the author particularly emphasises and explains the details which are necessary to high-class work. If wiring contractors and wiremen would carry out the instructions given in this book, there would be little complaint of unsatisfactory electric light wiring. Although the author gives as his opinion that wood-casing is likely to be in general use long after many of the present systems have been forgotten, he deals fully with metal conduit work.

The chapters on "Wires and Cables" contain useful information and sound advice. The author rightly points out that "the careless handling and connecting of the flexible cord have led to more failures and complaints against the electric light than anything else."

The chapter on "Joints" is illustrated from photographs. The author devotes considerable space to this portion of the work, but reminds the reader that joints should be avoided as far as possible.

As an example of the practical nature of the book, it may be noticed that the author advises front connections to all distributing boards—a point frequently overlooked, but of considerable importance.

The work concludes with a specification and a description of a country house installation. This is given to assist architects and others interested in electric lighting. The use, as suggested, in one room of lamps running in series is not good, and a three-way switch of the pattern advised would not be installed at the present time. With these exceptions, the arrangement is good.

The book fulfils the claim of the author that it is a practical work, suitable for the use of students taking courses in wiring and electric lighting at technical schools.

The Steam Engine Indicator and Indicator Diagrams. By W. Worby Beaumont. London : The *Electrician* Printing and Publishing Co., Ltd. Second edition. Price 6s. net.

The reviewer was one of the many engineers who were nurtured on the first edition of this book. Passing from recognised text-books on steam engineering in general to its particular details, he then found Mr. Worby Beaumont's book to be the most illuminating of those he perused on the subject of the indicator. Therefore, the second edition came in the guise of an old friend, filled out through the accretions of intervening years. Not, however, expanded to bulkiness, but merely enlarged to describe new forms of indicator gear which have been evolved to meet the modern conditions of high speed, high pressure, and (in internal combustion engine) high temperatures. Historically accurate, free from aught but simple mathematical equations, it is no less useful in its new form, than when it first appeared. That usefulness will continue, even if the present tendency to belittle the term "indicated horse-power" spreads as it bids fair to do. With the direct coupling of engines of all kinds to electric generators, one branch of the profession at any rate speaks and thinks in brake-horse-power-hours or kilowatt-hours. Even the successors of this generation will—unless everything be turbine driven—need the indicator, which is to an engineer what the stethoscope is to the doctor, namely, the discoverer of the way in which the valve gear is performing its functions.

Electricity Meters. By H. G. Solomon. London : Charles Griffin & Co. 1906. Price 16s. net.

This book deals fully with this much-neglected and very badly treated, but most important instrument. The subject is an interesting one, and deserves close attention from supply engineers, who will find this work both interesting and instructive. The author regrets that it is difficult to keep this class of book up to date, but as mention is made of the Holden electrolytic meter, he has succeeded better than is usual.

In the introduction the author classes maximum demand indicators as meters ; it is a pity that he has not confined the use of the word meter to the integrating watt-hour or ampere-hour meter, and not included under the general style "meter" such other devices as clocks and ammeters, which are other names for hour meters and maximum demand indicators. The author suggests that too many meters cannot be used by the station engineer. This cannot be called a very sensible statement.

The important question of error limits has been gone into fully, and the figures given for the limits allowed in Germany are worth attention. The method is scientific, but as it allows an error of 6 per cent. at full load, our own regulations are superior. The author rightly points out that the error limits for small meters are too narrow. Attention is called to the common method of installing meters which are too large for the ordinary full load, and yet always specifying that meters must be capable of carrying overload.

The author deals fully with the requirements of and gives a great deal of information about present-day meters, and goes fully into the principles of them. It is incorrect, however, to say that alternating-current meters are always watt-hour meters ; "nearly always" is more accurate. There is an unnecessary display of mathematics whenever possible.

In dealing with three-wire meters, the author shows the possibilities of errors when the two sides are unbalanced. The errors are not of much importance when the shunt coil is connected between the outers ; they only amount to 2 per cent. if the pressures between the two sides differ by 20 per cent., and the currents also by 20 per cent. The worst case occurs when the shunt coil is connected to one side only of the system. This, surely, is an unusual and obviously erroneous method, not requiring much mathematics to prove it. Perhaps the ignorance of some engineers may warrant its being dealt with, but there is no need to give the errors, as is done in the appendix, to the $\frac{1}{1000}$th part of 1 per cent.

The main portion of the book is devoted to descriptions of meters, which are complete and well illustrated. We read that tramcar meters must carry 25 per cent. overload almost indefinitely. This is one of the unpractical remarks found occasionally, and suggests more book knowledge than practical experience.

The portion of the book dealing with alternating-current

induction meters should be especially valuable, as the literature in this country is scarce, and nearly all meters of this type are of foreign origin.

The author concludes with a chapter on the mechanical features necessary for a good meter, and one on the testing of meters. There is a table of percentage errors for every 1th second above and below 60 seconds, from 40 to 80, but the author has not pointed out that owing to the difficulty of measuring $\frac{1}{5}$th second accurately, 60 seconds is not long enough for testing meters. This part of the work is, however, full of important points which deserve the careful attention of those engaged in testing meters.

The work is commendable, and the printing and illustrations are good.

Modern Milling Machines. By J. G. Horner. London : Crosby Lockwood & Co. 1906. Price 12s. 6d. net.

Modern milling is by no means so modern as many workshop men imagine, for we have sometimes been surprised to find special milling machines of long standing in old-established shops—machines of a type that we had regarded as essentially modern. The earliest milling tool is probably the saw for timber.

The saw has also been used for metals for many years, both in flat and circular form ; but the saw was not an instrument of precision, but merely one of division, which should leave surfaces that could be finished by more accurately working tools. As a matter of fact, the principle of the milling cutter is found in the common grindstone, the surface of which is roughly hacked into numerous divided areas, each of which represents a distinct cutting edge ; for it is by the multitude of cutting edges that the milling cutter does its work in its own special way.

The really modern cutter, however, is rightly stated to be due to the emery wheel as a precise grinder. A milling cutter blank is turned and bored out of annealed tool steel. On this accurate blank teeth are cut by milling cutters, the finished cut blank is hardened, and it is finally finished by accurate grinding upon an emery wheel. Without this grinding no cutter, even if sharp, could do good work, for it is always somewhat warped out of shape by the process of hardening, and on even the best of work each revolution of a milling cutter is often visible, be it only by a variation in the light reflected from the milled surface by reason of some microscopic inequality of cut. The author states that Vaucanson, who died in 1782, made milling cutters, and one is in existence in the United States with teeth shaped as for gear cutting, but fine and of irregular pitch, and not unlike a saw.

As milling has extended its operations over a wider field, so have the forms of milling machines varied and other machine tool forms have been pressed into the service. One cannot finish a long surface true by milling, but lathe beds are now rough cut by a single built-up milling cutter which roughs out the whole of the top surface of the bed at one operation. In this work the cutter is carried by a horizontal spindle borne on the cross slide of what is practically a planing machine with a slow movement of the bed. A lathe bed thus machined is then ready, after a rest of three weeks or so to cast off its internal stresses and warp, to be finish planed. Wheel blanks are now turned, ready for gear cutting, in a milling machine, and the teeth are cut on the blank of another milling cutter. Surfaces are machined flat by inserted tooth cutters carried on vertical or on horizontal spindles in modified forms of slotting machines, the spindle of the cutter replacing the vertical slide of the latter.

The boring mill is modified to form a milling machine, and generally the milling machine, as with other machine tools, takes on as many shapes as does the chameleon hues ; the time-honoured six machines—the lathe, the drill, the boring mill, shaper, slotter and planer—no longer are distinguishable as distinct machines, but all merge into each other, as special tools are now made for particular pieces of work.

All this and much more may be gathered in or from between the lines of Mr. Horner's book, and shopmen who have not got away from the *régime* of the single cutting tools, but who would like to do so, should study this book.

The milling machine is not one for careless or unskilled attendance, nor is it a machine that can be set to work on the silicified surfaces of castings straight from the fettler's brush. For success to attend on milling, the fettler's brush must be a spray of water following a 24-hours acidulation with dilute sulphuric acid, for no milling cutter will keep an edge on the skin of a casting. Matters would be even worse did not the cutters work, so to speak, up-hill, the silicious surface being attacked only at the commencement of a cut.

In the book before us will be found descriptions of the usual forms of milling machines, such as the plano-miller, the Lincoln miller and the Browne & Sharpe Universal miller. These various machines are well illustrated by sections of details, and their salient points are well brought out.

Needless to say, when working on steel the most copious lubrication of the cutter preferably with lard oil is necessary, while with cast-iron dry working, as usual, prevails.

Milling cutters in themselves are a subject of considerable study. The speed, rate of feed, number and pitch of tooth will all bear a load of argument pro and con, while the relation of spindle diameter to cutter diameter has naturally a close connection with machine capacity, for small cutters cannot have heavy spindles, and heavily pressed work will deflect a spindle until the stress is so great that the cutter bites freely and runs into the work, only to cease cutting as the pressure is relieved. These and other points all come under the author's purview.

The making of cutters is somewhat briefly treated, but this is a book for users rather than makers, and we fancy few manufacturers can make milling cutters as cheaply as they can be made by firms who give their whole energies to small tool making. Cheaply and well to make milling cutters it is requisite to have special machine tools and special hardening furnaces. But every firm should sharpen its own cutters—preferably in the tool room department—and we are glad to see that the author speaks favourably of the custom pursued by many men of finishing the operation with a slip of oilstone or a carborundum stick. A cutter thus sharpened will do better work. There is a useful chapter on indexing, calculations and special work, on pitches and spirals, &c., and a chapter on spur and bevel gears and on feeds and speeds. Indeed, the book is really very complete, and there are few shopmen who cannot learn from it.

Machine Tools. By Thos. R. Shaw. Manchester : The Scientific Publishing Co. Price 15s. net.

Until within quite recent years we do not seem to have come across any book on machine tools in this country. Americans, who did so much at one time to develop certain classes of tools, brought out some excellent catalogues, and not a few excellent pamphlets on detail operations, but these were usually put forth by interested makers—albeit good. Tools have suddenly sprung into prominence once again in this country after long years of quiescence and almost death, and it has been a not unfortunate coincidence that the new tool steel alloys came into being at the same time, and that English machine tool makers have stepped ahead of all competitors. The importation of American tools at one time assumed large proportions, partly because there was much of real value in them, and partly because our own makers were then incapable of supplying the demand.

But the waking industry proceeded to possess a literature. In the present book the author, who is known already as a writer on the subject, deals, to some extent historically, with the various standard types of machine that have been developed under the names of Planing, Shaping, Drilling, Boring, Milling, &c. In connection with the planing machine section, there are some interesting diagrams furnished by Messrs. Crompton & Co., showing the absorption of power by the electrical driving of the machines. Indeed, the introduction of electrical driving has enabled the discovery to be made of what power is required for all manner of tool driving. Various motor drives will be found illustrated, and there are a large number of excellent illustrations to scale showing machine details.

So far as we can judge in a book so full of detail and crowded with information, the author's views are good and

sound, his criticism and comment fair, and his dynamics correct.

There is a final general chapter containing many useful rules and calculations.

The School Magnetism and Electricity. By R. H. Jude, M.A, D.Sc. London: W. B. Clive. 1906. Price 3s. 6d.

This book forms one of the well known University Tutorial Series. It is intended for use in secondary schools and technical colleges. The author examines carefully the foundations on which the modern theories of magnetism and electricity are built, and the careful reader will obtain from this book a clear grasp of the fundamental facts and principles. The conception of potential is introduced almost at the beginning, and the entire treatment is founded on it.

We confess that we have not very clear ideas as to what "electricity," or for the matter of that, what "potential" is. Still, perhaps, it is hardly wise, even in a treatise for senior students, to let them into the secrets of the prison house so soon. On p. 25 we read, "this influence is called *Electrical Pressure*, or more commonly Potential." And also, "but electricity is *not matter*, and what the nature of electrical pressure may be is not known." It must seem curious to the uninitiated to be studying a science which is based on a conception, the nature of which is not known. Dr. Jude's statement also that electricity is *not matter* is, perhaps, a trifle too dogmatic.

The conception of the potential gradient which the author uses freely throughout the book is admirable. It may be objected that he is using something the nature of which is not known, but this objection does not apply to the utility of the conception. Just as we can use imaginary quantities in algebra, or for the matter of that in the practical theory of the running of alternators most usefully, so we can use the conception of potential gradient in electrical engineering. We wish that the author had adopted Prof. J. J. Thomson's suggestion and called it electric intensity. It would be then understood much more easily by electricians who are familiar with magnetic intensity.

The author's treatment of capacity, and his clear exposure of the fallacy of the old theory of "free and bound" charges are to be commended. Altogether his treatment of the theory of electrostatics is distinctly good. The discussion of electro-dynamics, however, is a little too sketchy.

A useful summary is given at the end of each chapter, and there are numerous sets of examples from the London Matriculation papers, &c. This will prove a most useful book to the student who thinks for himself, and is not prepared to accept assertions made on the authority of well-known names. For students, however, who trust to their memory rather than to their thinking faculties, we could name more suitable books.

Elements of the Differential and Integral Calculus. By W. A. Granville, Ph.D. New York: Ginn & Co. Price 10s. 6d.

In the preface it is stated that this volume is the result of an effort to write a modern text-book on the calculus which shall be essentially a drill book, and one in which the principle that each result should be made "intuitionally as well as analytically evident to the student has been kept constantly in mind."

We congratulate the author on his production, which is exceptionally good. As a drill book it contains about 1,700 well selected examples. Typical examples are solved in the body of each chapter, so as to enable students the more easily to apply the principles to particular cases. A large number of the examples have been selected on account of their physical significance. The latter part of the book treats of the simpler forms of differential equations.

Altogether the book contains all that is necessary for most physical and engineering problems.

Here and there we notice slips, *e.g.*, on p. 258, example 1, $\frac{d\rho}{\theta d}$ should be $\frac{d\rho}{d\theta}$.

On p. 366, example 17, the solution is arrived at simply by assuming $e^x - 1 = z^2$, instead of $e^x + 1 = z$ as suggested.

We have studied the book carefully, and can only in justice to the author heartily recommend it to students beginning the calculus.

Single-Phase Commutator Motors. By Franklin Punga. Translated by R. F. Looser. London: Whittaker & Co. 1906. Price 3s. 6d. net.

The problems connected with the design of single-phase commutator motors are of considerable commercial importance at the present time, and so a highly original work on the subject by one who is obviously thoroughly at home with both the theoretical and the practical questions involved will be of great interest to many workers in this field. The author does not spare the reader. He assumes that he is familiar with the ordinary theories of electrical generators, and he forces him to think out several difficult points for himself.

On a first reading of the work we have learned many novel practical ways of considering the electrical and mechanical actions taking place during the working of a motor, which more than counterbalance the labour of reading new proofs of old theories. The average student will probably be more attracted by a book full of easy platitudes, blocks from makers' catalogues, and extracts from papers read to technical institutions. To the thinking student, however, this book will be most useful.

With the exception of the use of J for current, and W for resistance, the symbols used are passable. The author's mathematical deductions from his assumptions are made carefully, and there are few misprints. In diagrams 16, 19, 20 I is written instead of J, and we presume that "vectorally" on p. 51 is a misprint for vectorially. In a foot note to p. 97 it is stated that "a reflection will make it clear that" the leakage factor "is larger for a single-phase winding than for a three-phase winding." We think that the author goes too far in making the reader think this out for himself. We consult books in order to find out the reason of these things. An engineer's intuitions are often right, but we prefer to see things for ourselves.

The two main problems discussed in the book are the effects of self-induction in the armature in diminishing the power factor and the sparking at the commutator. The treatment of the former problem is sound, and may be considered orthodox. The treatment of the latter is highly original, although based on Arnold's methods. The results are stated with a confidence which can only have been acquired by a lengthy practical experience, and the treatment is simple. It differs in many important respects, however, from other theories, notably those recently advanced by Latour, Press and Perret. It has the great advantage of simplicity.

In the first appendix a carefully thought-out theory of the repulsion motor is elaborated, and in the second appendix a description is given of recent tests on a series A.C. motor, made with an oscillograph by F. Creedy. The mathematical discussion in the first appendix is a little too condensed to make it easy reading, and as we understand that the author is contemplating a larger treatise, we hope that he will leave in more of the mathematical working.

Maver's Wireless Telegraphy. By William Maver, Jun. New York: Maver Publishing Co. 1905. Price $2.

This work is a fairly comprehensive treatise of the development of wireless telegraphy up to the year 1904, treated largely from the historical point of view. Taking into consideration the fact that the art is still more or less in its evolutionary stages, there is not at present a great deal to criticise in the work except that unless it is largely re-edited from time to time to keep pace with modern progress it will rapidly fall out of date. Indeed, the tendency to become old fashioned in some respects is already evident, owing to lack of information on one or two important aspects which the art has recently assumed. This, however, is rather a

misfortune than a fault. The book shows an intelligent grasp of the subject by the author, but a postponement of a year or two in its production would probably have lent him sufficient confidence to enter into some discussion of the merits of the various theories and systems which he describes, and to delete a number of descriptions of purely "paper systems," which it now contains. So many would-be inventors have rushed into the field of wireless telegraphy, and so much trash has been written on the subject that it is a difficult matter to sift the dross from the gold. The work, however, is distinctly above the average of treatises on the subject, and the matters referred to above are the most open to serious criticism.

As far as possible the author has avoided treating the theory of the subject from the mathematical point of view, and has restricted himself to popular explanations. The opening chapters deal with the early history of the subject, followed by brief descriptions of such systems as those of Phelps, Edison, and Preece. In alluding to the methods of wireless telegraphy by induction and spreading of currents, however, the author has omitted any reference to what is, no doubt, the most remarkable of these earlier methods, viz., the system of wireless telephony, of which some use is still made in this country by the Post Office. Possibly the author has never heard of it, though it accomplishes the clear transmission of speech over some three or four miles of sea.

In treating of the theoretical principles underlying the production and propagation of electric waves, considerable attention is given to the idea of detached loops of strain travelling through the ether, and to the notion of grounded loops or "sliding waves" to explain wireless telegraphic effects, on principles primarily set out in this journal.

The chapters devoted to descriptions of systems and details of apparatus are, for the most part, clear and well written, each system being fairly dealt with, and no undue preference for any particular method being evidenced.

It is principally in references to the methods of tuning and production of resonance that the work shows signs of falling out of date. It contains no reference to the coupling question, which has assumed such importance in this connection. It is mainly by the method of linking or coupling resonant circuits together that perfection in tuning and resonance can be attained. In this respect a careful re-editing would be of service, and would greatly enhance the value of the book, whilst the proper application of the principle to existing systems of wireless telegraphy is already resulting in the remodelling of many of them.

The work is, on the whole, a careful and accurate account of wireless methods, so far as they were developed two or three years ago, but it will require very considerable revision to embrace the soundest up-to-date practice.

Synchronous and other Multiple Telegraphs. By Albert Cushing Crehore, Ph.D. New York: McGraw Publishing Co. 1905. Price $2.00.

The first part of this book deals in an interesting and instructive manner with the explanation of a duplex-diplex Morse system, by means of which, on a line having about 10 or 12 stations in circuit, any two stations can work to each other direct current simplex, whilst the same two stations, or any other two stations, can work to each other an alternating current simplex system at the same time. Such a system essentially applies to conditions which do not obtain in this country. A two-page description of obtaining a quadruplex system by means of superimposing an alternating current duplex worked through condensers on a circuit already fitted with direct current duplex is given. On p. 46 is found the following:—"If synchronous telegraphs ever come into more general use, it is difficult to say how the problem of obtaining synchronism will be solved." It is also stated that the number of circuits that can be worked on a line is reduced by one when synchronism is obtained on the working line itself, and the author suggests as a remedy that a heavy copper wire should radiate from a centre to various termini, and be used solely for obtaining synchronism between this centre and the termini. It should be remembered that the Baudot multiplex is in general use in France, and works well between London and Paris. In the Rowland type printing multiplex, the actual working currents are utilised for maintaining the synchronism, and it is probable in practice that when the lines joining stations are long and follow different routes to the synchronising wire, the effects of variable weather in different districts will render the actual working conditions anything but ideal.

"The Method of Controlling Synchronous Motors by Relay Contacts," given on pages 52 and 62, is very similar to that adopted in the Rowland multiplex.

The results of some careful and elaborate experiments on the manner in which the received currents are split up on the segments of a receiving sunflower in a synchronous system of multiplex are very interesting, as are also the descriptions of working in opposite directions on the same wire by means of independently adjustable sunflowers, &c.

The book may be regarded as a treatise on the general application of alternating currents to telegraphy for the purpose of increasing the number of separate instruments which can be worked on a single line at the same time, and also as an extensive experimental investigation into the many and various conditions which must be fulfilled in order to produce and maintain a satisfactory system of synchronous multiplex telegraphy. There is not a great deal that is new to be learned by the telegraph engineer who has had much experience in dealing practically with multiplex telegraphy, and there are no descriptions of such well-known multiplex systems as the Baudot, Rowland-Typewriting, Delany and Mercadier.

Practical Electro-Chemistry. By Bertram Blount. 1906. Second Edition. London: Archibald Constable and Co., Ltd. Price 15s. net.

This is a reprint of the second edition revised and brought up to date; the first edition was published in 1902, and the second in 1903. It is divided into nine sections, the fifth being newly added. This section deals with the electro-metallurgy of iron and steel, and in 10 pages describes in a very concise manner the progress which has quite recently been made in this direction, and the present position of affairs.

The earlier experimenters endeavoured to smelt the iron direct from its ores by simply replacing the heat energy of the fuel by electrical heat energy, but since the blast furnace is a more direct and, to some extent, a fairly efficient method of utilising the heat, the cost of electrical heat energy in almost all localities has proved greater than is the case in the more direct blast furnace. Where, however, the problem of refining iron or of producing high-grade steels or ferro-alloys has to be considered, the question of fuel economy, as compared with manipulative and chemical difficulties, is less important, and electric furnace refining of the pig is already showing signs of commercial application. Sec. 5 therefore deals mainly with electric refining and steel and ferro-alloy production, and in it are described and illustrated the Héroult, the Kjellin, the Gin and the Keller furnaces.

The chapter on electroplating and electrotyping has been retained, and this would seem almost a pity, as this branch of electro-chemistry is to be found treated in other text-books much more fully, whereas here the space might have been better taken up by additional information regarding the electrolysis of chloride solutions, upon which so little is to be found in practical book form.

The author has, however, retained, and even enlarged, the chapter on "Alkali, Chlorine and their Products," which, in view of the scattered form of the present text-book information on this point, makes his book valuable to the student.

Twenty-three new illustrations have been added, making a total of 69; these are chiefly in connection with iron and steel and the electrolysis of chloride solutions.

The book retains its old outward form and is thoroughly well indexed.

Electricity as Applied to Mining. By Lupton, Parr and Perkin. London: Crosby Lockwood & Sons. Price 12s. net.

This work has now reached its second edition, and the comparatively short time that has elapsed from its first issue shows that a demand for a text-book of this type exists.

A thorough revision has been made, and much additional new matter has been added, the latter being rendered necessary by the rapid extension of the application of electric power in and about mines.

The subject matter is of a distinctly useful nature, and is well adapted to the needs of that section of the community for which it has been written. The joint authorship, although it has much to recommend it, tends to overlapping, and consequently one is prepared for the small amount that we find at various places throughout the book. We are of opinion that no special end is served by stating Ohm's law as the authors have done, namely, $A = \frac{V}{R}$ using A for the current in amperes, and V for the pressure density in volts instead of the usual C and E; this is more marked, since in certain other parts the usual conventions are adopted. While no fault can be found with the statements, it is perhaps, on the whole, easier for the beginner to master his subject if uniform methods are adhered to in dealing with what are in reality similar quantities.

On p. 70 the authors put forward a strong claim for polyphase motors for coal-cutting, but seem to neglect or ignore the very important fact that it is impossible to place an alternating-current motor in as small a space as a continuous-current motor of the same power, a most important factor in fixing the class of motor to be used for driving a coal-cutter.

The chapters on pumping and hauling and coal-cutting occupy 42 pages, an amount of space by no means representative of the importance of these operations, as they form the most likely cases for the effective application of electric power, of any connected with the mine.

Again, in discussing winding, the authors are of opinion that, so far as speed and control are concerned, as good results can be obtained with electric plant as with any other, and that steam consumption is less.

Few would contest these statements nowadays, but the ultimate economy is not generally conceded, and Mr. Mountain, whose paper they quote, has recently shown that the very plant they describe is less economical than many large steam plants at present doing this particular class of work. Their further remarks on the subject of winding are, however, pertinent, and very much to the point.

On the whole, the book is well suited to the needs of the colliery manager and mining engineer, and to mining students in general, and we have no hesitation in recommending it as a suitable work for those who are interested in the application of electricity to the needs of the miner.

The Energy Chart. By Capt. H. R. Sankey. Rugby: Frost & Sons. 1905. Price 10s. 6d. net.

The author endeavours in this book to explain the application of the entropy diagram, or as he now terms it, the energy chart, to heat engines. A fair sized chart is enclosed for 1 lb. of H_2O. The impression created by the book is one of respect for the mathematical facility of the author, and a strong feeling that students who begin early may use this method of engine analysis, but that older engineers will not make much use of it. The author is much too familiar himself with the subject to make it clear to the reader. Thus the latter will not find that the first paragraph on p. 27 is easy to read with the energy chart, nor p. 26 either. He will be unable to derive from the chart the figures in the letterpress. A more elementary explanation of the relation of the chart to the ordinary tables of properties of steam would have been desirable.

The application of the chart is explained in reference to the compound and triple-expansion and other engines, but we think that the whole subject might be more clearly treated. That is to say, we would have it put into a shape suitable for other than the mathematical gymnast. In this respect, however, all mathematicians are alike. They are themselves masters of a great science, and nothing will persuade them to step down from the high estate and write books for less learned men. On the contrary, they write for those as clever as themselves, and these are just the men who can do without their books. We fear that the difficulties of this book will rather tend to discourage those who might be willing to take up the subject. The entropy diagram for the engine must be originated from the P.V. diagram, and this is so much simpler to work upon, that for all ordinary calculations it is probably superior to the newer method which becomes too lengthy and complicated under practical conditions.

We do not seem to have seen any advance in steam engineering science from those who use the entropy chart. Now, if steam engines had been designed *ab initio* by men familiar with physics, one would have expected to find that smooth internal surfaces were in use years before they were introduced. Scientific steam engineering of the sort one connects with entropy does not seem to get beyond the paper stage. To students who cannot read this book with facility we would recommend a preliminary study of Prof. Ripper's book on "The Steam Engine." Thus, Ripper in explaining what entropy is says, "Entropy is length on a diagram whose height is absolute temperature, and whose energy is heat units." This seems to us to be an explanation of what entropy is that we have not met with elsewhere, and we are surprised that other writers do not endeavour to convey meanings as clearly. No one has, perhaps, done more on the subject of the entropy diagram than the author of the book before us, and we should like to see him extend his work to the end that the wayfaring engineer, though a fool, shall not stray therein. There is nothing like an unfamiliar and strange word for disinclining men to study new methods and new ideas. To such, the work of Ripper will lead the way to the book under review.

Armature Windings of the Closed Circuit Type. By W. Cramp. London: Biggs & Co. 1905. Price 1s. 6d.

This little book appears to have been written for students and for apprentices at the winding bench. Starting from a simple Gramme winding, the author leads up, in a most careful and detailed manner, to the forms of multipolar drum winding which are now universal, omitting those complicated forms of winding which are not now fashionable. The nomenclature adopted is that of Parshall and Hobart, so that the book may be regarded as an introduction to the larger works on dynamo machinery.

Modern Electric Practice. Edited by Magnus Maclean, M.A., D.Sc. London: Gresham Publishing Co. 1904. 6 Vols. Price 9s. each net.

In these excellent volumes an attempt has been made to compile a comprehensive treatise on modern electrotechnics. During the last few years the subject has advanced so rapidly that it has become well-nigh impossible for any single writer to deal with any hope of success, with such a wide range of subjects as are here treated. The editor of the work, Dr. Magnus Maclean, has, therefore, obtained the co-operation of a staff of 34 experts, to write each in his special department of theory and practice. Many of these are names in the front rank of their subjects, and it was therefore with some diffidence that the reviewers undertook the task of writing their notice of the work for these columns. They may take this opportunity of expressing their regret that this review has been so long delayed, but the delay has nevertheless served a purpose, in that it has enabled them now to testify as to the usefulness of the work in question, which they have frequently had occasion to consult.

The general get-up of the books is all that could be desired; they are well printed on substantial paper, and no pains have been spared to obtain ample and up-to-date information on the subjects dealt with. The diagrams and curves are very well reproduced. Some of the information contained in the volumes has probably never before been rendered accessible in book form, and we believe the work will be useful as a reference book, not only to the student of electro-technics, but also to the specialist.

The work is divided into five sections comprised in six volumes. The first of these sections includes the measuring, generating, transforming, and storing of electric currents; the second, electric lighting and power distribution; the third, electric tramways; the fourth, boilers and prime movers; and the fifth, miscellaneous applications of electricity.

Vol. I consists of five divisions:—

1. Electric and magnetic measurements, by Dr. Hay ;
2. Alternating current measurements, by Dr. Marchant ;
3. Continuous current generators, by Messrs. Mountain and Leggat ;
4. Alternating current generators, by Mr. Berg ; and
5. The continuous-current motor, by Mr. Snell.

On the perusal of almost any part, the first impression made is almost certain to be that of the thoroughly practical character of the book. After a long course of the semi-ignorance which passes for knowledge in the academic type of text-book, where a current measurer is denoted by a circle with a line across it, and the only figures of instruments and apparatus are confined to types which ought long since to have been relegated to the museum, it is refreshing to find here information not only as to methods, but as to the construction and details of the very many forms of instruments available in electro-technical work. Such a figure as fig. 27 gives an excellent explanation of the inner workings of a modern moving-coil ammeter, and throughout the book the combination of explanatory diagrams with series of photographs of the apparatus discussed gives a graphic idea of the actual article, whether it be the imposing field-magnet frame of a 2,700-KW. generator, or the bifilar suspension of a moving-coil galvanometer.

In the earlier parts of the chapter on alternating-current measurements is found a lucid explanation of the phenomena of wave-form, phase-difference, vectors, &c., which are not easy matters to render clear, and the chapters on the continuous-current motor contain a mine of information even to the specialist. For example, it is doubtful if the information contained in the section on the electric motor as applied to electric lift work, along with curves illustrating all the properties of such an installation, has ever been previously available in book form. The diagrams on p. 257, showing the current necessary for the electric driving of various collections of machine tools by different systems, are very instructive, but no mention is made of the voltage of the supply in this case.

The mistakes we have detected are not numerous. Poggendorff was not the inventor of the form of potentiometer shown on p. 49, though he was probably the first to determine the E.M.F. of one cell in terms of that of another by means of a calibrated slide wire.

In the second volume of this work the first section is entitled "The Measuring, Generating, Transforming and Storing of Electric Currents." There is little to be found in it, however, about the measuring of current, and we think that the first portion by Mr. Field on A.C. motors would have gained a great deal in practical value if one chapter had been devoted to the testing of induction motors, with an elementary explanation of the Heyland diagram. No mention or explanation is made of the factor $\frac{\text{light load current}}{\text{short circuit current}}$, which is the key to nearly all that the practical man requires to know about a motor. For the rest Mr. Field gives an elementary and clearly illustrated explanation of the theory and construction of A.C. machines, although the testing of generators and the predetermination of voltage drop are quite ignored. We congratulate the author on condensing so much information into the space of 74 pages, but are of opinion that to be of real practical value double this space should have been allotted to so important a subject.

The chapters by Mr. Berry on static transformers form an exceedingly useful addition to the book. He deals with the main points to be considered in the design of transformers under different conditions of load factor, and describes methods by which bogus loads may be obtained for test purposes. We cannot help noting the comparisons which are made between the Berry transformer and those of other types, never, apparently, to the detriment of the former.

The chapters devoted to storage batteries give little more than short descriptions of various cells which have been or which are at present on the market—and here, again, we wish that the author had dealt more with the practical running of cells and less with the historical side of his subject. One looks in vain in this volume for some remarks on the diseases of cells, their causes and remedies.

The chapters on switches and switchgear give an excellent account of the best modern practice in both small and large gears. The illustrations are very good, the types treated of being representative of the principal British makers.

The volume closes with seven short chapters of practical value on electric mains, their running underground and jointing, &c., with a discussion on fusing and fault localising in distributing circuits.

Volume III of the work is entitled "Electric Lighting and Power Distribution," with a few chapters at the end on the permanent way for tramways. The first five chapters, by Mr. Esson, deal in a comprehensive way with the subject of power equipment and distribution. After a description of the various systems with their relative advantages, the author goes on to describe different typical power stations, examples, however, which are apparently taken from any country in the world but Great Britain. His concluding chapters on transmission lines and the cost of electrical energy are written in an interesting and lucid way, and contain much useful information.

The next 90 pages are on the subject of electric lighting and wiring, with a very fully illustrated section on fittings, artistic and otherwise. The chapter deals with the supply only after it has reached the consumer's premises, and does not treat of the installation and balancing of three or five-wire systems in towns.

The chapters on arc and incandescent lamps, by Messrs. Biliotti and Robertson respectively, form a most valuable addition to this work. Mr. Biliotti illustrates and describes the principal makes of arc lamps, and gives a certain amount of data regarding their performance in practice. We should have liked, however, to see more data comparing watts per mean spherical candle-power taken by the different types described. In his article on the incandescent lamp, Mr. Robertson gives a most interesting and well illustrated account of the manufacture of carbon filament lamps, explaining the objects of the various processes, and concluding with data regarding the most economical lamps to use at different costs of electric power, which the ordinary user of lamps would do well to study. Mr. Robertson's intimate and life-long acquaintance with glow lamp manufacture shows itself in the exceedingly practical and thorough way in which he has treated his subject.

The concluding chapters in the book by Messrs. Wignall and Watlington deal in an instructive way with the subject of permanent way for street tramways. The chapters are well written and fully illustrated.

(*To be concluded.*)

Elementary Electrical Calculations. By W. H. N. James and D. L. Sands. London : Longmans, Green and Co. Price 3s. 6d.

This little book of 212 pages is evidently intended for elementary electrical engineering students. It is divided into nine chapters, beginning with one on Units, then Ohm's Law, Power and Work, Conversion of Energy, Electro-Chemistry, and Photometry. It also contains a series of examples for the student to tackle, and answers are given at the end of the book.

In the chapter on Units we are informed that the English unit quantity of work is the foot-poundal, but in the next paragraph the authors write : "A more common unit is the foot-pound." Now, what is the use of the foot-poundal to British engineers ?

B.A. "ohms" are also dug up out of their grave and resuscitated. Surely B.A. "ohms" do not exist in Manchester, and in an up-to-date college ?

The Hydraulic Analogy, and Ohm's Law are duly dealt with in the old, old style, and in these chapters "mhos" are introduced to the reader. The writer has never met any electrical engineer, or physicist, who ever used a "mho" in actual life. It is met with only in papers set at exams. by cranks, and is of no earthly use to anyone.

Graphical methods are used freely throughout the book, and are even introduced to calculate the resistances of wires in parallel. The reviewer thinks graphical methods are overdone nowadays, and all the straight line business is sheer waste of time. Surely a student can understand "varies as" and its applications. If he does not, the straight line will not help him much.

The chapters on "Conversion of Energy," and "Power and Work," are clearly written, and in "Transmission of Power," the graphical method is usefully applied to show Kelvin's law, and should interest students. The following chapters on "Electro-Chemistry" and "Photometry" contain useful examples to the elementary student.

Altogether the book is above the average "electrical arithmetic," and the numerous worked examples should be helpful to the student. The diagrams and printing are excellent.

A table of logarithms at the end might further enhance the value of the book.

Engineering Tables and Data. By W. W. F. Pullen, Wh.Sc., M.I.E.E. Manchester: The Scientific Publishing Co. Second edition. Price 2s. 6d.

When opening a book on engineering tables, one can reasonably expect to find information bearing directly upon the subject. The book under review is decidedly disappointing in this respect, for an engineer will not find much that could not be obtained from an up-to-date treatise on heat.

The book contains 81 pages, of which 45 are devoted to pure mathematics, and a synopsis of mathematical formulæ, having no direct physical reference at all.

Fourteen pages are devoted to the properties of saturated steam, leaving 22 for everything else. These 22 pages contain Temperature Conversion Diagrams, Table of Water Pressure, Density of Water, Specific Heat, Combustion Constants, Mechanical Equivalent of Heat, Superheated Steam, The Throttling Calorimeter, Temperature Entropy Table, Thermal Efficiency of Steam Engine and British and Metric Systems.

There are no tables or data on the mechanical, magnetic or electrical properties of iron and steel. There is nothing mechanical about it.

If an engineer or student of engineering requires such formulæ as $\tan x = x + \frac{x^2}{3} + \ldots$ he surely requires $v^2 = 2fs$; kinetic energy $= \frac{1}{2} m v^2$, and so on.

One might have expected tables of constants on the strength of materials, but such information is conspicuous by its absence.

The binding and general get-up of the book are good, but the back covers a multitude of sins—of omission.

Practical Pattern Making. By Herbert Aughtie, A.M.I.Mech.E. Manchester: The Scientific Publishing Co. Price 4s. net.

The author has written primarily for pattern makers, foundrymen, and apprentices, but his clearly-written and well-illustrated book may be commended to the drawing office. The latter department is often not so thoughtful as it might be, and is responsible for designs which, with care and attention, might be handled more cheaply by both pattern-makers and moulders. The book is chiefly written for the pattern-maker, but foundry methods are freely discussed, as the construction of a pattern and the preparation of the mould require simultaneous consideration.

The general scope of the book may be best judged from the headings of some of its chapters: I. Moulding in Green Sand—contraction—taper—details of construction—machining allowances—filleting—rapping and lifting plates—cores and core prints—dowels. IV. Patterns Built in Segments—turning tools—templates and chucks—open joints. V. Pipe Patterns—fluted columns. IX. Fragile Patterns—patterns for plate moulding—sectional patterns. X. Toothed-wheel patterns—worm patterns. XI. Arrangement of Core-boxes—use of plaster of paris—screw propellers—oblique patterns—framed patterns. XII. Boxed-up Patterns—horizontal flanges—solid patterns built up in sections—additions to patterns due to exigencies of casting—registration of patterns.

THE NEUTRAL MARKETS OF THE WORLD THEIR OPPORTUNITIES.

IV.—Peru.

As in Brazil, so also in Peru, the natural advantages of the country, in the shape of easily accessible water power, combined with the development which is taking place in its industrial and commercial relations, offer great opportunities for the extension of electrical enterprise. Added to this, the Government is prepared to give the greatest possible encouragement to undertakings which have for their object the improvement of the country and its industries.

Peru covers an area of 695,743 sq. miles, and an unofficial estimate recently made gives the population as about 5,000,000. A wonderful expansion of enterprise has recently been shown in the matter of railways, lighting and other works, and it is, therefore, not surprising to find that the trade of the country has increased to a marvellous extent. Since 1900 the imports have almost doubled, until in 1904 they amounted to £4,298,003. The figures for 1903 were £3,783,380, and for 1902 £3,428,283. The exports, on the other hand, have gradually and consistently decreased, from £4,498,000 in 1900, to £4,067,000 in 1904. The imports from the United Kingdom are greatly in excess of those from other countries, and are slightly in excess of those from Germany and the United States together; the imports from these two countries, however, have increased in recent years in a far greater ratio than those from the United Kingdom. In the case of the United States the imports have increased 300 per cent. since 1900. Moreover, the completion of the Panama Canal will, it is anticipated, give a wonderful impetus to the trade of the United States with Peru, so that British manufacturers will have to pay great attention to the market if they wish to retain the trade they at present hold, and at the same time to gain their share of the increasing demand.

The detailed figures of trade are extremely belated—the last published statistics deal with 1902; the following particulars will, however, give some idea of the trade in electrical goods in that year, although they cannot by any means represent the trade as it is to-day, for the years since 1902 have shown such a remarkable development that the import figures in this class of goods must have greatly changed. The imports of telegraph and telephone apparatus in 1902 amounted to £2,789, of which £101 were from the United Kingdom, £1,141 from Germany, and £901 from the United States. The imports of pump machines, motors, &c, amounted to £136,214, of which £50,948 were from the United Kingdom, £20,755 from Germany, and £56,263 from the United States. Other machinery was imported to a value of £27,035, the United Kingdom being credited with £5,726, Germany with £5,072, and the United States with £12,909. The imports of copper wire amounted to £5,791; the imports from the United Kingdom were valued at £1,519, those from Germany at £2,147, and those from the United States at £1,778. Railway carriages were imported to a value of £1,014, of which £98 were from Great Britain, £491 from Germany, and £270 from the United States. The total imports of machinery and parts thereof in 1902 amounted to £167,476, and in 1904 these figures had increased to £206,151. The imports of metals and manufactures thereof, which amounted to £414,049 in 1902, increased to £872,601 in 1904.

From the above figures it will be seen that in every item the imports from the United States were greater than those from the United Kingdom, and it may safely be concluded that this position has not been altered in recent years, for it is surprising to find that in the majority of cases where new plant, &c., has been constructed the supplies have been obtained in the United States. British manufacturers are still neglecting the trade in electrical goods, which has had considerable importance in recent years, and bids fair to increase greatly in the future. It is gratifying to find, however, that on the whole the commercial intercourse between the United Kingdom and Peru is satisfactory, but there is no doubt that the trade might be increased if manufacturers and merchants would only study more closely the requirements of the market.

From a general point of view, a marked improvement has been shown in the financial and commercial conditions of Peru in recent years. The national income is more than double what it was 10 years ago, and a large sum is being set aside annually for railway construction. Credit is reviving, as is proved by the gradual and not inconsiderable influx of foreign capital, and the formation of new companies with capital raised in the country. In this respect it is gratifying to find that the largest financial undertaking in Peru, viz., the Peruvian Corporation, Ltd., with a capital of £16,500,000 is a British undertaking.

The present Government has among its chief aims that of covering the country with a network of railways, and of doing all that is possible to encourage foreign immigration and colonisation. It is prepared to give to concessionaires valuable consideration in the way of land grants, and to guarantee a sure percentage on the amounts invested in undertakings which have for their object the development of the industrial and commercial condition of the country. It is hoped to raise an annual income of £200,000 by farming out the proceeds of the tobacco tax, this sum to be used for the purpose of the extension of railways, and the construction of roads and bridges. The roads as a rule are steep and bad, and it is anticipated that with easier means of locomotion there would be an immediate development of many of the inland districts, which abound in mines and fertile land, but which, nevertheless, are little frequented and poor. It will therefore be

evident that great opportunities exist for the application of electricity for traction purposes, particularly in view of the wonderful supply of natural fuel which exists in the shape of accessible water-power. In recent years there has been a great development in the construction of electric railways, and in most of the undertakings it will be found that United States manufacturers have secured orders for the material. The Lima and Callao and the Lima and Chorillo electric railways were opened to traffic in 1904; the lines were constructed and are operated with Peruvian capital, but American material was used. For the Lima and Callao tramway, the contract for the line was obtained by Messrs. Bolan & Dillon, and for the power station by Messrs. W. R. Grace and Co. The trolley system is employed with Brill and Stephenson cars. The line between Callao and La Punta—a neighbouring sea bathing resort—has also been opened to traffic, as well as the tramways in Callao itself. A contract was signed in the early part of last year between the Provincial Council and the Ferrocarril Urbano de Lima for substituting the electric overhead trolley system for horse traction on the tramways of the company, the work to be finished within two years. It has also been decided to make an extension of over 3 miles of new line, to be ready within the five following years. A new company representing American and local capitalists succeeds the old one, and the electrical and other material required for the undertaking has been ordered in the United States, as happened in the case of Lima's two suburban lines, now in successful operation. Moreover, an association of Lima capitalists has been formed to build a second line of electric tramway between Lima and Barranco, Miraflores and Chorillos. The railway from Guaqui, on Lake Titicaca, to the Alto of La Paz, which was opened to traffic in the early part of 1904, has now been connected with the city of La Paz by an electric railway.

The installation of wireless telegraphic communication is also being carried out in Peru, and a contract was entered into last year by the Peruvian Government with a German company for establishing wireless telegraphy between Puerto Bermudez, on the Pichis, and Masisea on the Ucayali, the ultimate intention being to communicate with Iquitos, on the Amazon. The Peruvian Government are, however, debarred by their new contract with the Central and South American Telegraph Co., from using the system of wireless telegraphy between Peru and the neighbouring Republics to the north.

The soil of Peru is rich in ores of many kinds, and the mining industry is advancing rapidly, so that there should also be an opening for electrical enterprise as applied to the treatment of metals.

Amongst the electrical plants in operation in Peru may be mentioned that of the Empresa Electrica de Santa Rosa, with alternating current from six General Electric single and three-phase steam-driven generator sets of 5,000 kw. This plant is stated to be the largest electrical power plant at present existing in South America.

The condition of Lima itself has been wonderfully improved in recent years by the carrying out of electric railway, lighting, telephone and telegraph works; so much so, that it is gradually superseding Callao, which it bids fair to absorb, along with other coast towns in the vicinity. There should, therefore, be still plenty of opportunity for electric traction and other electrical works in the town and district. An electric lighting plant has recently been installed in the town of Iquitos, which is also undergoing great developments.

As has already been stated, Peru possesses a valuable element in the yet undeveloped hydraulic power which exists on both the eastern and western slopes of the Cordilleras. The source of this supply is the ice-cap which crowns the summit of the range, and the continual and exceedingly heavy snow and rain storms of the high plateau. All along this vast chain there exists a series of lakes practically astride the summit of the Andes at altitudes varying from 12,000 to 17,000 ft. above the sea level, and these, with the stream to which they give rise, form the source of enormous hydraulic energy. The volumes of water which descend on the Pacific side are not necessarily very great, but they are numerous and constant, and their fall is exceedingly rapid. As an example, the River Rimac, which rises on the ice-cap of the Cordillera, at an elevation of more than 17,000 ft., joins the sea at Callao, with a course not more than 80 miles long. This river is already used as motive power for generating electricity for the Lima-Callao line mentioned above, and could furnish constant and unlimited power over any portion of its course. Similar conditions exist as regards the numerous other rivers and streams passing through the country. In this respect it may be mentioned that a well-known electrical engineer was recently commissioned by the Government to estimate the resources of Lake Titicaca, with a view to its use for the production of electrical energy. The engineer in question is stated to have reported that by using the stream at Arequipa a force of 6,000 h.p. would be obtained, the power necessary for supplying the southern railways of Peru. The surplus could be used for lighting the towns, for agricultural and mining operations, and perhaps for electrical navigation. It is stated that the project is likely to be carried out for supplying energy for the above-mentioned purposes.

Electrical apparatus of all kinds pays a general duty of 40 per cent. ad valorem. Valuations are fixed by the Customs authorities. The valuations for accessories, switches, contact makers, &c., vary from 60 cents per kilogram to 1·50 sols per kilogram according to the material of which they are made. Insulators are valued at from 7 cents to 30 cents per kilogram; wire and cables from 4 to 85 cents per kilogram; flexible cords from 2·5 to 3·75 sols per kilogram; arc lamps, 15 to 30 sols each; incandescent lamps, 3·5 sols per dozen; electric light meters, 15 sols each; Morse's telegraph apparatus, 22·5 sols each, without clockwork, 11 sols each; electric bells, 1 sol each; carbons for arc lamps, 18 cents per kilogram; insulating pipes from 35 to 50 cents per kilogram. Steam or electrical machinery of all kinds, and hydraulic and other motors, are free of duty, as are also agricultural and mining machinery, foundry machines, &c. Customs duties are payable in silver sols (sol = 2s.). Merchandise imported through Callao is liable to a sur-tax of 1 per cent. for the purpose of defraying the expenses of the construction of a National Theatre.

The currency is composed of gold, silver and copper coinage. Gold is the commonest medium, and that in use is almost entirely in British sovereigns, of which a considerable number are imported annually.

The following are firms interested in electrical undertakings and the importation of electrical goods:—

Lima.—Empresa de Timbres y Aparatos Electricos; Empresa Electrica de Santa Rosa; W. R. Grace & Co. (agents for the General Electric Co., of New York); Ludowieg & Co., calle de Ucayali; Lima Electric Light Co.; P. Burbank, calle Quilca; C. M. Schroder & Co., calle Mechormalo; C. P. Soldan; Peruvian Telephone Co., Apartado 846; Chorillos Gas Works; Siemens and Halske Aktiengesellschaft; E. F. Wagner; Central and South American Telegraph Co.; West Coast of America Telegraph Co., Casilla 209; Peruvian Telegraph Co., Casilla 155; Cia del Ferrocarril Electro de Lima y Callao.

Mollendo.—Fabrica y Cia de Electricidad; Bucetich & Co.

Cerro de Pasco.—The Cerro de Pasco Co.

As is the case in other parts of South America, a good deal of the trade is done by large importing houses in Peru, who have their own buying agents in Europe, where payments are made against shipping documents. Direct trade is, however, increasing, and a good deal of business could be done by suitable travellers. It is useless to send out catalogues in English, even although they may be illustrated. Spanish is the language of the country, and weights and measures should be quoted in the metric system. In employing agents and in doing direct trade great care should be taken to prove the reliability of the firms dealt with.

Every facility is given to commercial travellers; they are allowed to enter with their samples on presenting to the Custom House, through a responsible agent, an official request to pass so many packages of samples. A bond is presented by the agent who undertakes to pay the amount of duty leviable in respect of any of the samples that may not be re-shipped within the term specified, which is usually 90 days. This process will cost the traveller from 10s. to £1, and he is then free to go where he likes with his samples, without giving an account of them in any part of the interior. Besides his business card, the traveller should take a letter of recommendation to some known resident in the port through which he enters the country, so that the agent may satisfy himself as to the status of the traveller. Should a commercial traveller enter Bolivia through Mollendo with his samples and not return to Peru, he must send a certificate, signed and *viséd* by the Peruvian Consul at La Paz, to the effect that the said samples have entered Bolivia. The Arequipa municipality compels travellers to take out a licence, the cost of which is £2 10s. per quarter.

ELECTRICAL PATENTS EXPIRING IN 1906.

(*Concluded from page* 576.)

16,046. "Electrolysis." H. Y. Castner. September 7th, 1892. Electrolytic production of caustic alkali, chlorine and hypo-chlorite. A cell is constructed having two or three chambers separated by non-porous partitions and communicating underneath by means of a moving layer of mercury or alloy. One form of construction consists of a cell with two chambers which are separated by a partition, through which passes a shaft carrying a driving pulley at the top, and radial helical arms at the lower end. These arms move in a layer of mercury and tend to carry it round from one chamber to the other. One chamber is filled with water and the other with brine. Chlorine is liberated in the anode chamber and escapes as such, or is converted to hypochlorite. The liberated metal amalgamates with the mercury, and is carried under the cathode cell, where it forms hydrate. The apparatus is supplied with a cooling chamber, through which water circulates. The mercury may be kept moving by means of pistons or by tilting.

16,588. "Oxygen and hydrogen." P. Garuti, Italy. September 16th, 1892. (Date given under Sec. 103 of Patents, &c., Act, 1883, April 25th, 1892.) Oxygen and hydrogen are obtained by the electrolytic decomposition of water rendered more conductive by the addition of sulphuric acid, &c. The cell consists of a wooden chamber mounted on insulators and having a leaden or other suitable lining. The anodes and cathodes consist of sheets of lead arranged longitudinally in an inverted case, each of the electrodes being separated from its neighbour by a leaden partition or diaphragm. The electrodes are held in position by wooden combs resting on blocks, by split forks and by grooved end pieces. In a modified form the diaphragms only extend a portion of the way down from the upper surface. The electrodes are connected at either end to conductors, which are insulated where they pass through the electrolyte, the bare portion where the connections are made being protected by inverted troughs connected by perforations with the electrolytic chambers. The anode and cathode chambers are connected by perforations, with the collectors surmounted by glass tubes and pipes, having a liquid seal.

17,093. "Electric meters." W. E. Ayrton and T. Mather. September 24th, 1892. Relates to electrostatic measuring instruments and comprises the construction of details. To enable the terminals to be connected or disconnected with the circuit without danger of shock, they are enclosed in insulating material. The metal parts and binding screw are surrounded by insulating material and the terminal is combined with a readily detachable fuse-holder containing a fuse retained in position by a cap. An insulating and short-circuiting device (a modification of that described in Specification No. 11,862, A.D. 1890) consists of two springs actuated by an eccentric, and so arranged that the fixed parts of the meter, together with the parts connected with the needle, are first disconnected from the terminals and then connected together. In instruments with conducting cases insulated from the working parts, in order to prevent risk of shock, due to the unequal capacities of the parts connected with the respective terminals relatively to the case, a conductor may be attached to one of the springs so as to balance the capacities of the parts. To protect the instrument, spark gaps are so adjusted as to allow sparks to pass when the potential differences between the vital parts, to which the electrodes of the gaps are connected, are less than those required to cause sparks to pass between the vital parts.

17,160. "Telephonic switchboard apparatus." J. E. Kingsbury (The Western Electric Co., U.S.A.) September 26th, 1892. Apparatus for use in telephone switchboards. The apparatus consists in a special construction of spring jack and plug, and an annunciator. The spring jack is formed by cutting partial transverse grooves in a sheet of ebonite and perforating the front edge to meet a rectangular chamber. Three springs are secured by a screw in the grooves, one spring being connected to earth and the other two being connected to the lines. A thimble and ring are let into the perforated front edge of the ebonite sheet. The plug is formed with two insulated contact pieces, which are connected to the cord. These make contact with one of the line-springs, and the thimble and ring respectively, another ring being placed in front of the thimble contact piece to close the circuit between the remaining springs. The annunciator is formed with two coils, each provided with armatures. One armature carries a hook arm, which holds the other in position until the first is attracted by its magnet. When the second armature is released from the hook it falls forward, thus raising a shield, at the same time closing a local circuit. When the restoring magnet is excited its armature is attracted and caught by the hook at the same time dropping the pivoted shield.

17,169. "Electrolysis." C. Kellner, Vienna. September 26th, 1892. An apparatus for electrolytically decomposing metallic salts in which the active portion of the cathode consists of mercury, the liberated metal forming an amalgam therewith. The amalgam is withdrawn from the apparatus if the metal is required, but if a salt or hydrate is required, the amalgam is brought into contact with acids or water. The figure shows one form of apparatus suitable for electrolysing sodium chloride, in which are suitable anodes and cathodes, consisting of cases of cement, water-glass, &c., having tubes in the form of a grid containing mercury. The upper part of the cathode is enlarged, and when a hydrate is to be produced is filled with water. The cathodes divide the cell, so that the electrolyte can be made to circulate from end to end by means of tubular connections. There are provided a tube for drawing off the chlorine, and connections for causing the alkaline solution produced to circulate along the cathodes. Various forms of the apparatus are described, in which the enlargements of the cathode form supplementary cells, a cathode being inserted, the exposed surface of the mercury forming the anode. This cell may be on short circuit, or the dynamo or other generator may be connected to the extra cathode, so that the electrolytic and supplementary cells are in series. Various forms of the mercury electrode are described, in which amalgamated fabrics, &c., are enclosed between two plates of asbestos, &c.

17,826. "Electric currents." M. Hutin and M. Leblanc, both of France. October 6th, 1892. Converting alternating currents into direct and *vice versa*. Consists in using an induction coil or transformer, the coils of which are connected together, and wound in a special manner. The coils have a varying number of turns, which are calculated according to formulæ given in the specification. The coils are connected in series, and also with the sections of a commutator. The brushes rotate, whilst current is supplied to them through two fixed rings connected to the generator. The brushes are rotated by a synchronous motor, or the commutator may rotate, and the brushes be fixed. In another arrangement, the two sets of coils are mounted on a single circular core concentric with the commutator. Other arrangements are described for converting three-phase currents, &c. In modifications the number of turns in the coils may be constant, the width of the strips of the commutator being varied.

17,911. "Artificial crystals." P. M. Justice. (E. G. Acheson, U.S.A.). October 7th, 1892. Relates to the production of hard crystals composed entirely, or nearly so, of carbon and silicon, thus being carbide of silicon or silicide of carbon, which are useful for grinding and abrasive purposes, as the incandescent portion of an electric lamp, and for other purposes. Consists in heating a mixture of a carbonaceous and a silicious material. A suitable mixture is one of 50 per cent. pure carbon, 25 per cent. of silica, or aluminium silicate, and 25 per cent. of common salt for use as a flux. This mixture may be placed in an electric furnace having a conducting core for use at the commencement of the process. After passing the current for a suitable time the crystals form, and may be separated from graphite and other impurities, broken into pieces, boiled, and washed by decantation, and subsequently dried. The crystals are called "carborundum," and may be made up into wheels, disks, cloth, paper, or other convenient forms.

17,982. "Dynamo-electric machines." A. J. Boult. (L. Boudreaux, Paris.) October 8th, 1892. Brushes composed wholly, or partly, of one or more superposed folded sheets of metal foil. The sheets may be of the same or different metals, or they may be coated with deposits of kindred or other metals.

18,039. "Electrolytic apparatus." J. Hargreaves and T. Bird. October 10th, 1892. Electrolytic cells and diaphragms are formed of wire netting, or perforated sheet metal upon which a layer of porous material, such as asbestos, is deposited in the form of pulp. A layer of Portland or other cement is then deposited on the fibrous material. In some cases the layer of fibrous material may be omitted. The wire netting, &c., may be used as the cathode; an anode being placed in the porous cell.

18,116. "Electric lamps." W. Mathiesen, Germany. October 11th, 1892. Arc lamps. An electro-magnet in a shunt circuit has a pole-piece furnished with an extension for the purpose of preventing the armature being released until the arc is properly formed. The supports of the armature are pivoted and carry a train of wheels, about the lowermost of which passes a chain connecting the upper and lower carbon-holders. The train ends in a fan which engages with a pivoted stop provided with a spring tending to put the stop out of gear. The upper carbon-holder is heavier than the lower, but the pivot of the lowest wheel is arranged at one side of the pivot of the armature supports, so that the distance of the chains supporting the holders are inversely proportional to the weights of the holders, and consequently the difference in weight has no turning effect in the armature. In operation, the carbons being separated are brought together by the action of the magnet, which pulls over the armature frame, liberating the fan from its catch and allowing the train of wheels to run. On contact of the carbons the action of the magnet diminishes and the frame turns back under the action of a spring sufficiently to strike the arc. The increased resistance of the magnet coil when it becomes heated is compensated by connecting the spring to a compound metal strip constructed so that at temperatures above the normal it bends towards the spring and diminishes its tension. Alternative devices upon the same principle are also described. A form of lamp containing a differential solenoid instead of an electro-magnet is also described.

18,516. "Electrolysis." E. N. A. Picard and J. A. Tanière, both of France. October 15th, 1892. In the electro-deposition of metal, such as copper, silver, iron, gold, or zinc upon mandrels, &c., the deposit is continuously beaten by hammers. In one construction of the apparatus there is a cathode brush bearing on a mandrel and an anode consisting of a metal plate and a tray which contains granular or other pieces of the metal to be deposited. A carriage runs on guides between two cells, and carries an electro-magnet having a trembler armature as in an electric bell. This armature is connected by links to pivoted levers carrying hammers. The levers have extensions which are connected by a spring, and are controlled by a second spring which ensures a sharp blow. The hammers may be actuated by mechanical means, such as a triangular shaft, instead of by electric agency.

18,871. "Alkali manufacture." J. Hargreaves and T. Bird. October 21st, 1892. Relates to the production of alkali and chlorine by electrolysis. A solution of sodium chloride is charged into a cell made of porous material such as is described in specification No. 18,039 A.D. 1892 (see above). Around the cell and in contact therewith is a cathode of wire gauze or perforated metal. The cell is enclosed in an exterior vessel in which are provided inlets for steam and water and an outlet for the alkali. The porous jar contains a carbon anode and has a cover in which is an outlet for the escape of chlorine. The space between the porous jar and exterior vessel contains no liquid except such as is injected or condensed from the steam sent in, such water and steam being employed continuously or intermittently, to wash off the alkali from the cathode as it is formed. In the provisional specification the solution is placed in the outer vessel, and the empty cathode compartment is arranged in the centre.

21,794. "Ozone." E. Andreoli. November 29th, 1892. Relates to electrodes for ozonisers, such as described in Specifications No. 17,426 A.D. 1891, and No. 9,631 A.D. 1892 (see above). Consists in forming the electrodes of plates of tin or other metal cast or stamped so as to form sharp edges, tongues or angles, protruding from one or both sides, or by fret-saws or their equivalents, or serrated wires or the like supported on a frame or on cross-bars.

18,994. "Electro-magnets." I. A. Timms. October 22nd, 1892. Consists of a brass bobbin with one or more coils and having an internal tube or rod of magnetisable metal, connected by a base-plate with an external tube also of magnetisable metal. The armature is in the form of a plate with a rim and a central core to which an actuating rod may be attached. The length of the armature core and rim may be increased and the tubes correspondingly shortened; or either the core or rim may be dispensed with. A combination of three such magnets is also described.

22,187. "Lightning arrester." R. Belfield. (The Westinghouse Electric and Manufacturing Co., U.S.A.) December 3rd, 1892. A lightning arrester is formed of cylinders of metal such as zinc, cadmium, bismuth, &c., set on parallel axes. Two or more cylinders may be employed, the centre or an end one being connected to earth.

22,914. "Printing telegraph." W. L. Wise. (C. L. Buckingham, U.S.A.) December 13th, 1892. A system of printing telegraphs in which the type-wheel is mounted on a sectional shaft, the sections being connected by a series of impellers, drivers and followers, arranged to give motion to the type-wheel in the ratio of 1, 2, 4, 8, &c. The type-wheel may have several circles of letters, and these circles may be brought to the printing position by means of a similarly constructed shaft, and a rack on the type-wheel shaft. The transmission is effected by means of an automatic transmitter having a series of fingers which make contact with a cylinder through perforations in a strip. The fingers correspond in number to harmonic relays, plus one for sending ordinary Morse currents. The receiver contains a similar series of harmonic relays which actuate the followers, plus one for actuating the unison and spacing devices. A printing lever may be actuated periodically by an eccentric on a motor shaft, or it may be driven by a motor and released electrically whenever a letter is to be printed. The unison device may be at either transmitting or receiving station, and is provided with a commutator geared to run at one-twentieth the speed of the motor. Another commutator at the other end runs at the same speed, and if in agreement sends no synchronising current; but if not in agreement, a current is sent through one of the two magnets whose armatures feed an arm one way or the other, thus cutting out or putting in resistance into the motor circuit, and so adjusting the speed of the motor.

22,915. "Printing telegraph." W. L. Wise. (C. L. Buckingham, U.S.A.) December 13th, 1892. A printing telegraph system in which the signals are transmitted by means of a Wheatstone automatic transmitter. An alphabet is employed in which the dots and dashes are formed by perforations producing six reversals of the current for each letter, when from 16 to 32 symbols are employed. One form of the receiving mechanism consists of a relay operating a distributor with six sections. Five of the sections are connected to resetting relays controlling the circuits of five electro-magnets for operating a printing mechanism of the type described in Specification No. 22,914 A.D. 1892 (see above). In this apparatus the type-wheel is moved to its required position by the accumulative action of 1, 2 or 3 magnets on a sectional shaft; the other two of the magnets being employed to set the required ring of type in position. The sixth section of the distributor allows of the resetting of the relays when the signal is completed. A second form of the receiving apparatus consists in employing several series of resetting relays arranged in tandem, so that the currents forming the signal select the required relays, and when the signal is complete close the circuit of one of a series of electro-magnets which operates one of the levers of a typewriter.

22,931. "Telegraphic apparatus." W. L. Wise. (C. L. Buckingham, U.S.A.) December 13th, 1892. Telegraphic apparatus comprising essentially the adaptation of an electric synchronous movement to printing and multiple asynchronous systems. In one form of apparatus for a printing telegraph if the automatic transmitter and relays with their circuits were removed, the distributors and the synchronising devices would be the same as for multiple Morse signalling. The automatic transmitter and the relays are arranged for that type of apparatus in which the type-wheel is brought to the required position by the combined action of several magnets on a sectional shaft. The distributors are driven by motors and are provided with trailers. A differential relay is so arranged at the transmitting station that if the trailers are in unison on the end segments, the line current has no effect on the relay. If, however, one trailer is on any other contact the relay is excited and sychronises the motor by the action of a battery on the auxiliary armature. Indicator dials are also described for showing the state of the two motors, the pointers being moved on one step for each revolution. The motor at the transmitting station is provided with a second armature running between the same magnets. The coils on the armature do not form a complete circle, the commutator segments having no connections. The centre coil of the armature is connected to a commutator segment which is extended through to a sleeve. One of the brushes bears on this sleeve, and the other on the divided commutator.

22,987. "Galvanic batteries." P. M. Justice. (W. W. Griscom, U.S.A.) December 14th, 1892. Secondary batteries. Plates or electrodes are made with holes or piercings variously arranged. The plates are preferably made from forced lead, and are honeycombed or pitted on the surface by heating them in an alkaline solution. Lead in a state of fine division is then deposited on the surfaces of the plates which are then formed either with or without being coated with lead oxide.

23,892. "Multiple telephony." M. Hutin and M. Leblanc, both of France. December 27th, 1892. Multiple telephonic apparatus arranged to work with currents of high alternating periodicity. A transformer has its secondary connected to a line and has its primary connected to a number of interrupters giving different rates of alternations. Each transmitter is provided with an induction coil, the primary of which contains the microphone, a call and a condenser by which the circuit is balanced for a particular rate of alternation. Receivers are similarly balanced so as to respond to only one particular rate of vibration. The transmitter employed in this system consists of two divided rings of carbon resting on each other, the parts of the upper and lower rings being arranged to break joint; the diaphragm consists of wood or ebonite. The receiver consists of two coils arranged as an electro-dynamometer, one of them being attached to the diaphragm. The call employed is formed as the receiver, but has an oscillating contact maker in circuit.

24,127. "Galvanic batteries." F. King. December 31st, 1892. Secondary batteries. Plates or electrodes are made with longitudinal projecting ribs or pins, covered with insulating material, which prevent the plates from coming into contact with each other.

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

1904.

Apparatus for Controlling and/or Supplying Current for Power and Light on Consumers' Premises During Certain Periods. A. M. Taylor. 25,620. November 24th.

1905.

Fuses for Electrical Circuits. W. E. Richards. 26,144. December 15th.

Dynamo-Electric Machines. Allgemeine Elektricitäts-Ges. (Date applied for under International Convention, January 20th, 1905.) 27,198. December 30th.

Apparatus for Converting Multi-Phase Current into Continuous Current. Bruce Peebles & Co., Ltd., and J. L. La Cour. 343. January 7th.

Brush Holders for Dynamo-Electric Machines. J. W. Burleigh. 2,098. February 2nd.